PAYMENTS *for* ECOSYSTEM SERVICES *and* FOOD SECURITY

PAYMENTS *for* ECOSYSTEM SERVICES *and* FOOD SECURITY

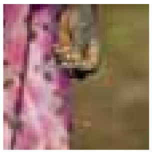
Food and Agriculture Organization of the United Nations | 2011

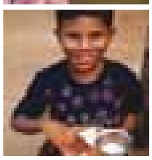
ISBN 978-92-5-106796-3

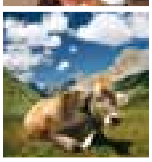
Editorial Note

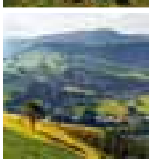
This publication was edited by Daniela Ottaviani and Nadia El-Hage Scialabba, Natural Resources Management and Environment Department, the Food and Agriculture Organization (FAO) of the United Nations. The editors wish to thank all the authors who prepared the different chapters and sections and those who provided cartographic and photographic materials, as well as Patricia Balvanera, Rebecca Goldman, Tara Moreau, Noémi Nemes, Amy Rosenthal for their valuable suggestions to specific sections of this publication. Special thanks go to Bryan Hugill for language editing and to Pietro Bartoleschi and Arianna Guida for the design and desktop publishing of this publication. The FAO is grateful for the generous support of the Swiss Federal Office for Agriculture (FOAG) to this project.

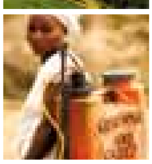
CONTENTS

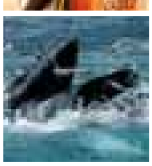


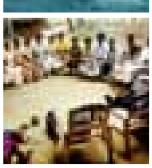


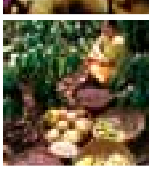


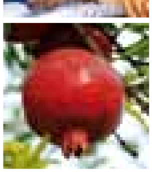












CASE STUDIES

VIEWPOINTS

ABBREVIATIONS AND ACRONYMS

CAFNET	Coffee Agroforestry Network
CAP	Common Agricultural Policy
CBSM	Community-Based Social Marketing
CDM	Clean Development Mechanism
CGIAR	Consultative Group on International Agricultural Research
CIFOR	Center for International Forestry Research
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
COP	Conference of the Parties
CVI	Conservation Values Index
EBI	Environmental Benefits Index
EFTA	European Free Trade Association
ES	Ecosystem service
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FOAG	Swiss Federal Office for Agriculture
FONAFIFO	Fondo Nacional de Financiamento Forestal / National Fund for Forests Financing
GAEP	Good Agricultural and Environmental Practice
GEF	Global Environment Facility
GHG	greenhouse gas
GI	Geographical Indication
GTZ	Deutsche Gesellschaft für Internationale Zusammenarbei
ICRAF	World Agroforestry Centre
IFAD	International Fund for Agricultural Development
IUCN	The World Conservation Union
Kagera TAMP	Kagera Transboundary Agro-ecosystems Management Project
KENGEN	Kenya Electricity Generating Company Limited
KMFT	Kodagu Model Forest Trust
MDG	Millennium Developing Goals
MEA	Millenium Ecosystem Assessment
MKEPP	Mount Kenya East Pilot Project
NGO	Non-governmental Organization

OECD	Organization for Economic Co-operation and Development
PDO	Protected Denomination of Origin (Ukraine)
PDO/PGO	Products of Distinct Geographical Origin
PEHS	Payments for Hydrological Environmental Services Program
PES	Payment for Ecosystem Services
PGI	Protected Designation of Geographic Origin (Ukraine)
PRESA	Pro-Poor Rewards for Environmental Services in Africa
RAF	rubber agroforest
REDD	reduction of emissions from deforestation and forest degradation
RES	Rewards for Ecosystem Services
RUPES	Rewarding Upland Poor for Environmental Services
SARD-M	Sustainable Agriculture and Rural Development in Mountain Regions
SFSO	Swiss Federal Statistical Office
SPP	Sustainable Public Procurement
TRIPS	Agreement on Trade Related Aspects of Intellectual Property Rights
UK	United Kingdom
UN	United Nations
UNCSD	UN Conference on Sustainable Development
UNDESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UNEP-WCMC	UNEP World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	UN Framework Convention on Climate Change
USA	United States of America
USAID	United States Agency for International Development
USGS	United States Geological Survey
WFP	World Food Programme of the United Nations
WOCAN	Woman Organizing for Change in Agriculture and NRM
WTA	willingness to accept
WTO	World Trade Organization
WTP	willingness to pay
WWF	World Wide Fund for Nature (formerly World Wildlife Fund)

FOREWORD

Changing climate, loss of native forests, disappearance of biodiversity, water shortages, desertification, the reduction of natural soil fertility — all add to the scenario of a world with increasingly complex environmental challenges. But further complicating this scenario of environmental degradation is the fact that these situations are unavoidably linked with other global challenges, such as financial crises, increasing social inequality and population pressure, all of which contribute to the untenable number of people on our planet who do not have enough to eat, a number now estimated at almost a billion.

The gravity of these global challenges certainly raises questions about what, until now, has been the status quo — the way we operate agricultural production systems, the value we attribute to natural resources and ecosystems, the way our resources are shared, and how they are conserved for future generations, if at all. The concept of Payment for Ecosystem Services (PES) has emerged as a challenge to the all-too-prevalent tradition of taking the Earth's natural resources for granted. PES highlights a global continuum, illustrating the relationship between our lifestyles, the demands associated with our production and consumption patterns, and the effects those demands have on close or distant ecosystems.

PES can be used as a benchmark by which policy-makers, investors, NGOs, landowners and local people who benefit from ecosystem services can evaluate their approaches and determine if they are supporting a sustainable model of development. In this case, sustainable would mean that it recognises the right of people to guide their own development, seeks environmental integrity, enhances economic resilience, supports food security and embodies *the principles of equity and justice. Those who embrace PES embark on a journey that requires thoughtful steps, starting with putting a monetary value on natural resources and developing market mechanisms to protect ecosystem services.*

The desire to stay in a comfort zone is truly a part of human nature and, if not properly designed, PES may indeed tend to favour quick, linear and easy solutions that reduce problem solving to a level of control and comfort. However, even with such a design, the actual implementation of PES will require the courage of commitment — that is, commitment to understanding the deep complexities of existing challenges. In this case, the way forward will not be toward a single, simple pre-determined solution, but instead through a process of negotiation and social dialogue that raises understanding within the community of the critical role that PES can play in protecting the Earth's natural resources and, in turn, future populations.

This book is meant to take those with background knowledge into new realms of technical understanding, but also to take newcomers to the PES mandate on a thoughtful journey, raising awareness in their consciousness as to what is needed and what can be accomplished by individuals with a strong sense of commitment. A functioning PES system has the potential to renew individuals' shared sense of responsibility and involve them in supporting initiatives that can contribute to the collective preservation of our planet. I hope that this book will awaken your enthusiasm for steering our development path in the direction of sustainability.

Alexander Müller
Assistant Director-General
Natural Resources Management and Environment Department
Food and Agriculture Organization of the United Nations

PREFACE

A healthy ecosystem can provide a variety of crucial services for public goods, such as clean water, nutrient cycling, climate regulation and food security — services that contribute directly or indirectly to human well-being. Yet today, many ecosystems are in decline; this is of particular importance to agriculture, which depends on ecosystem services. Loss of healthy ecosystems will seriously affect the production of food, both today and in the future.

Payments for Ecosystem Services (PES) is an economic instrument designed to provide positive incentives to users of agricultural land and those involved in coastal or marine management. These incentives are expected to result in continued or improved provision of ecosystem services, which, in turn, will benefit society as a whole.

Agricultural ecosystems are diverse, both in their nature and in what they produce. This means that, around the world, farmers have their own specific sets of challenges related to sustainable agricultural production, as well as linked to the socio-economic condition of their agro-ecosystem and the local cultural and business environments. For example, some ecosystems are constrained by water scarcity while others face loss of forest land, which, in turn, could lead to soil erosion and the loss of habitat for pollinators. At the same time, these agricultural ecosystems are all interlinked — through the global agricultural market.

The competition among products derived from different agricultural systems and the need for affordable food prices tend to result in general disregard of public goods and of ecosystem services, as well as of the sustainable management and use of natural resources. The result of such a lack of policy for protecting ecosystems is that related conservation costs are not captured in the marketplace. Subsequently, even if aware of the loss of ecosystem services and general environmental degradation, farm families — most often, the poorer *producers — are economically unable to afford the necessary conservation measures and precautions. That is why it is important to consider positive PES incentives, which would provide remunerations through market or direct payments and, in turn, give farmers benefits needed for improving their production and livelihoods.*

Some countries and international organizations already have experience in enacting PES. It is important to capitalise on their experiences and lessons learned, build upon those aspects that work and leverage political support for the wider use and further development of such policies and instruments. It is important to use these experiences to raise awareness of the benefits, and work with relevant policy-makers, including the UN, at national and international levels.

To address current environmental challenges and attempt to shape the future, it is necessary to disseminate information on options for managing ecosystems, including the public goods and services they provide, as well as on the inter-linkages of the food and agricultural sectors with other sectors. The Food and Agriculture Organization of the United Nations (FAO) is a major repository of expertise and information on food and agriculture. Its capacity and knowledge can be utilised to initiate global policy dialogue on PES that would involve the agriculture, environment, trade and finance sectors, and include partners from both civil society and the private sector.

On behalf of the Swiss Confederation, I would like to take this opportunity to express my appreciation to all those who have worked hard on this publication. In particular, I extend my sincere thanks to the farm families who participated in the case studies, the project collaborators, the national authorities, the donors, and the FAO and especially to Ms. Nadia Scialabba (FAO), the project leader.

Hans-Jörg Lehmann
Permanent Representative
Head of the Permanent Representation of
Switzerland to FAO, IFAD and WFP

“We can’t solve problems by using the same kind of thinking we used when we created them.”

Albert Einstein

INTRODUCTION

ECOSYSTEM SERVICES AND FOOD SECURITY

The Millennium Ecosystem Assessment (2005) defines poverty as the pronounced deprivation of well-being, which is achieved with provision of food and basic material needs, freedom of choice, health, good social relations and security. Poverty often arises from a broken linkage between human well-being and ecosystem services. More specifically, poverty is directly linked to food security, which refers to the supply and access to provisioning services, such as food, water, wood, fibres and fuel, that are, in turn, dependent on the healthy functioning of regulating services, such as climate change stabilisation, flood regulation, drought control, water purification, disease regulation, predation and pollination. Regulating services cannot function without supporting services, such as primary production (photosynthesis), nutrient cycling and soil formation and biodiversity. Above all, the biological diversity (including genes and species) that is found in natural environments constitutes the web of life that supports all ecosystem functioning and enables ecosystems to be resilient enough to external shocks so as not to experience significant changes in state. As such, the healthy functioning of ecosystems is affected by multiple interactions between various types of ecosystem services, resulting in a highly complex network.

Agriculture relies on the delivery of critical regulating ecosystem services

Agriculture generally also relies on the delivery of critical regulating ecosystem services, such as soil formation and micro-organism activity, erosion control, nutrient dispersal and cycling, water purification, reliable rainfall and stable climate, crop pollination, and pest and disease control. Modern intensive agriculture demands a continuous and constant trade-off between provisioning and regulating/supporting services. Productivity aims to increase the rate of provisioning services to the detriment of regulating services; however, when regulating and supporting ecosystem services are disrupted, food production is seriously affected, the result being a vicious downward spiral. Thus, there is an urgent need for mainstreaming agricultural policies, regulations and incentives related to the adoption of sound agricultural practices that both enhances the provisioning ability and resilience of agro-ecosystems.

In this interaction between human activities and ecosystems, there is a negative reinforcing feedback loop between poverty and ecosystem conditions because poverty is often related to ecosystem degradation, while ecosystem degradation often aggravates poverty. In fact, the disruption of ecosystem services tends to have more severe impacts on the poor than on the wealthy who have the necessary financial and social capital to access scarce resources or their substitutes.

Poor farmers generally lack the resources necessary to counteract reduced agricultural productivity with investments in water management and the use of proper agricultural inputs. The misuse of such artificial inputs often impacts the long-term provisioning ability of ecosystem services and contributes to make poor farmers ever more dependent on external inputs, increasing their dependency on cash flow and credit systems, putting them under greater financial stress and eventually putting their food security under major threat. The resulting lack of self-reliance of the food system, including the loss of control and management of farmers on their own activities and an increasing sense of hopelessness, can even bring farmers to the point of committing suicide. Globally, the suicide rate for farmers is higher than for the non-farming segment of the population due to higher indebtedness and loss of dignity. Thus, the preservation of the healthy functioning of ecosystem services represents a long-term insurance against poverty, food insecurity and overall human well-being.

The healthy functioning of ecosystem services are a long-term insurance against poverty and food insecurity

PES AND SUSTAINABILITY

Ecosystem services are public goods, but as no one actually owns them, there is generally very little incentive to preserve them. As a result, there are no direct market mechanisms to signal the scarcity or degradation of a service until it fails. Payments for Ecosystem Services (PES) aim to fill this gap by creating new marketplaces for services, such carbon sequestration, biodiversity conservation, watershed protection and landscape values.

In the most commonly-accepted definition of PES, as given by Wunder (2005), PES is a voluntary transaction whereby a well-defined ecosystem service (ES) is 'bought' by a minimum of one ES buyer from a minimum of one ES provider if and only if the ES provider continually secures the ES provision (i.e. with an element of conditionality).

A PES scheme can be put in place when: (a) the demand for at least one ecosystem service is clear and financially valuable to one or more 'buyers'; (b) the provision of ecosystem services is threatened, but the adoption of specific land-use/management practices has the potential to address the supply constraints; (c) a trusted intermediary is available to assist both parties in developing the negotiation and provide expertise in the PES design; (d) clear criteria are able to be established to ensure compliance of the contractual agreement by both parties; (e) land tenure and usage rights are clear; and (f) there is a cross-sectoral coherence between existing policies and laws and PES requirements. Although the private sector is becoming increasingly involved in most PES schemes, the main buyer is still the public sector, which is able to raise funds at the national and international levels and act on behalf of civil society to preserve ecosystem services and promote sustainability.

Sustainability is a multidimensional concept encompassing economic resilience, environmental integrity and social development. Sustainability means ensuring human rights and well-being, as well as achieving global food security without depleting or diminishing the capacity of the Earth's ecosystems to support life or at the expense of others' well-being. The attractiveness of PES is that it is able to form a bridge between the complex dimensions of sustainability because a PES scheme should be economically viable, socially just and tackled to the carrying capacity of natural systems. By definition, PES aims to provide incentives (i.e. the economic dimension) to preserve ecosystem services (i.e. the ecological dimension) such that they can continue to provide benefits to the society (i.e. the social dimension). Being a direct voluntary payment mechanism, PES would be expected to be institutionally simple, effective in providing to income generation and cash flow amongst suppliers, successful in the delivery benefits to buyers as payments are conditional on performance, and able to foster practical tools for the preservation and monitoring of ecosystem services. In reality, the complexity arising from the interaction of these three dimensions (economic, ecological and social) has been revealed during the last 15 years in which more than 300 PES schemes have been implemented around the world (Landell-Mills and Porras, 2002). Each PES project has faced particular challenges linked to ecological, socio-economic, political and cultural conditions in which was implemented. At the same time and due to this, each PES project reflected in a different way the economic, ecological and social dimensions. On the basis of the experience gained so far, PES schemes have also been evaluated from different perspectives and in various ways. From the economic perspective, it has been argued whether the occurrence of a PES scheme was actually able to provide true additionality (i.e. improve the delivery of ecosystem services, everything being equal); from the ecological perspective,

PES is a bridge between the complex dimensions of sustainability by being economic viable, socially just and within the environmental carrying capacity it is whether PES is an effective long-term option for conservation of natural resources and sustainable development; and from the social perspective, if PES reflects the principles of equity and justice and whether it can be an effective way for poverty alleviation. However, the key underlying question is whether it is indeed possible for a PES scheme to integrate these three dimensions and thereby ensure food security. If PES is not an efficient market-mechanism and does not adapt to reflect in time the true or perceived opportunity costs, it will not raise the stakeholders' interest to participate in such a voluntary scheme. In addition, if PES is not based on a robust environmental assessment and the understanding of the causes of disruption of ecological processes, the preservation/restoration of the ecosystem services will not take place. Finally, if PES is not designed to target poor landholders, to induce cooperation and to enhance community cohesion, the additional cash flow can trigger social conflicts and even aggravate food insecurity.

TOWARDS THE INTEGRATION OF THE ECONOMIC, ECOLOGICAL AND SOCIAL DIMENSIONS OF PES

In 2002, an International Conference on Sustainable Agriculture and Rural Development in Mountain Regions (SARD-M) held in Adelboden, Switzerland, established the multi-stakeholder Adelboden Group. This group, which backstopped the FAO project on SARD-M (2005-2010), identified PES as a priority for sustainability.

In order to provide insight in a new multidimensional generation of PES schemes, a stakeholders consultation on "Food security through additional income generation: From Payment of Ecosystem Services (PES) to Remuneration of Positive Externalities (RPE) in the agriculture and food sector", was convened by the FAO Natural Resource Management and Environment Department, with financial support from the Swiss Federal Office for Agriculture, from 27-28 September 2010 at the FAO Headquarters in Rome, Italy. Invitees from both developed and developing countries included researchers from the CGIAR and various universities (ICRAF, CIRAD and research institutes in India, Melbourne and Stockholm), NGOs (CARE-WWF, Euromontana, Heifer, IUCN, WOCAN), public officials from Bhutan, Chile, Costa Rica, Italy and Switzerland, the UN (i.e. IFAD, UNEP, WFP) and OECD representatives involved in the various aspects of PES.

The FAO stakeholders' consultation discussed lessons learned and enabling conditions for PES schemes, as well as innovative approaches

The stakeholders discussed lessons learned and enabling conditions for PES schemes, as well as innovative approaches to PES. The consultation conceived a deeper understanding of the complexity lying behind PES schemes and pointed out the need for the improved integration of the economic, ecological and social dimensions as a way to foster real change and pave the way for sustainable and effective PES implementation. The underlying complexity of this integration is likely to bring to the fore new synergies during development and implementation, as well as trade-offs, both foreseen and unforeseen.

This publication reviews the role of PES in agriculture and examines lessons learned from agri-environmental policies in the European Union and OECD countries for a new generation of PES schemes in agriculture.

In particular, it is evident that agriculture represents one of the main anthropogenic activities influencing the preservation or the disruption of ecosystem services. Although many PES schemes, often classified as water, carbon sequestration, biodiversity and landscapes, do not specifically refer to agriculture. They often attempt to mitigate the 'lose-lose' situations found where subsistence agriculture is unable to provide food security to local people and continues to erode natural capitals, compromising even more the supply of food and related ecosystem services (i.e. the 'poverty trap').

Further interesting suggestions arise from the development of agri-environmental policies in OECD countries. In many of these countries, several certification schemes have been put in place and have shown to be successful in incentivising different types of productive systems in agriculture. Community-based approaches, such as Landcare in Australia and watershed initiatives in Europe, have also proven to be a major driving force for change in agro-ecosystems.

This review also highlights how while PES schemes have an economic structure, they are also aimed at fulfilling the ecological and social dimensions, which present opportunities and gaps in their implementation. In particular, under the ecological dimension, the use of spatially-explicit cost-benefit analysis enables one to identify PES areas with high ecosystem service provision (i.e. benefits), areas with high risks to ecosystem services (i.e. threats) and areas with low opportunity costs (i.e. costs). Under the social dimension, there is also a need to take into account the motivational, social and cultural drivers of PES success. Once these drivers are carefully tackled, PES schemes are based on stronger social consensus and can be implemented through cooperation within the community.

The new generation of PES schemes could combine community-based initiatives and certification schemes. This landscape labelling approach publicises ecosystem service delivery, together with the cultural and symbolic attributes of the landscape. Furthermore, it has the potential to improve market recognition, secure premium payments and gain access to niche markets. The derived benefits can, in turn, provide the necessary incentives needed for managing the landscape in such a way as to continue to meet the ecosystem service criteria required for certification.

This review also examines the legal enabling conditions for PES and the potential of PES for a 'green economy'. PES schemes are voluntary contractual agreements and, by definition, need only a clear allocation of land property and usage rights to be effective; in reality though, the success of PES is often affected by the existing legal and institutional frameworks in which the scheme takes place. It is essential that PES schemes are implemented within legal frameworks that are harmonised at the sub-national, national and international levels. PES projects often reveal weaknesses or incoherences in the existing legal and institutional frameworks and, as such, can constitute small-scale pilot projects for mature national PES visions.

PES projects, as innovative cross-sectoral and inter-institutional bridges, often require enabling conditions and market interventions which, on a larger scale, are also considered as important propellers for the growth of a 'green economy'. However, the real contribution of PES to the development of a green economy depends primarily on the capacity to design a new generation of PES schemes in which the economic, ecological and social dimensions are fully integrated. Such PES schemes are likely to be the small-scale field trials for the development of a truly global 'green economy'.

REFERENCES

Landell-Mills, N. & Porras, I. 2002. *Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor*. Instruments for Sustainable Private Sector Forestry Series. London, International Institute for Environment and Development (IIED) (available at http://www.iied.org/pubs/display.php?o=9066IIED).

MEA. 2005. *Millennium ecosystem assessment. Our human planet: Summary for decision-makers*. Washington, D.C., Island Press.

Wunder, S. 2005. *Payment for environmental services: Some nuts and bolts*. Jakarta, Centre for International Forestry Research (CIFOR).

CHAPTER 1

THE ROLE OF PES IN AGRICULTURE

Daniela Ottaviani
Food and Agriculture Organization of the United Nations, Rome, Italy

CONTENTS

INTRODUCTION

Since the Rio Earth Summit in 1992, agriculture has been recognised as a key multifunctional sector able to provide benefits, other than only food and fibres, particularly with regard to sustainable agriculture and rural development (UNCED, 1992). Clearly, the main goal of agriculture is to make food available to households and to ensure food security at the local, national and international levels. Activities aimed at ensuring food production involve in different ways the environmental, economic, social and cultural dimensions of the food system.

From the ecological perspective, agriculture has a substantial impact on ecosystem processes because it uses and modifies all components of the ecosystem, including air, soil, water and biodiversity. From the economic perspective, agriculture provides a foundation for local economies by giving income to rural communities and by promoting the value of agricultural products throughout the value chain. In particular, agriculture is usually considered an engine of economic growth in developing countries (World Bank, 2009). With regards the social and cultural aspects, agriculture constitutes an important source of employment, improving rural livelihoods, and an environment conducive to the transmission of farming knowledge and traditions. Payment for Ecosystem Services (PES) is a tool that easily applies to the agricultural sector, as any activity therein inherently interacts with all the dimensions of sustainability (i.e. environmental, social and economic). In fact, PES can provide positive incentives (additional income or in-kind payments) for alternative land uses or particular agronomic practices at the farm level. The payment is, or should be, economically comparable to the forgone opportunities of existing alternative land-use options (i.e. opportunity costs). This payment is given to support land-use or agronomic practices which are able to protect or restore natural ecosystem processes. PES is expected to work where ecosystem services are under some degree of present or future threat and where the opportunity costs for alternative land use or land practices are not very elevated (Wunder, 2007).

PES can work in agriculture where ecosystem services are under threat and the opportunity costs for alternatives are not very high

These situations are often found in human-modified agricultural ecosystems (such as degraded pastures, marginal croplands, hillside remaining forest patches), where the original natural capital has already been exploited, often in an unsustainable way, and the resulting ecologically-degraded ecosystems have lost their resilience and are found in a state of disequilibrium. These impoverished agro-ecosystems experience a shortage or imbalance of one or more regulating services and for this reason cannot deliver a sufficient degree of provisioning services, such as food, water and fibres. It is clear that when the ecological equilibrium of agro-ecosystems is disrupted, this seriously impacts not only the land productivity (economic dimension), but also the living conditions of the resident population (social dimension). Ecologically-degraded areas can be considered as 'poverty traps' because they cannot ensure any current or future food security and, without the restoration of ecosystem processes, any further attempts to exploit the remaining resources reduces their ability to supply of food and deliver functional ecosystem services. These ecologically-degraded areas offer also few rewarding activities and employment opportunities; resident people might even be forced to migrate elsewhere, loosing potential assets. Livelihoods can also be directly impacted by under-nourishment, diseases and sanitation problems directly arising from the disruption of basic provisioning ecosystem services, such as food and water supply.

Ecologically-degraded areas can be considered as 'poverty traps' as they cannot ensure any current or future food security

According to the MEA (2005), 60 percent of the world's ecosystems are being degraded or used unsustainably. It is estimated that 85 percent of cultivated lands contain areas that are degraded by soil erosion, salinisation, soil compaction, nutrient depletion or unbalance, pollution and the loss of biodiversity. Moreover, each year 12 million hectares (an area approximately the size of Greece or Nepal) are lost due to desertification; an area of this size would be able to produce 20 million tonnes of grain and annually feed over six million people (WBCSB and IUCN, 2008).

Given the current challenges faced by our present patterns of production that have already reached the ecological limit of the planet, an obvious priority is to use the cropland already under cultivation in a way that ensures the preservation of ecosystem processes, prevents land over-exploitation and, consequently, irreversible long-term land loss. The 'side-effect' of protecting the very basis of agricultural productivity is the conservation and enhancement of all types of ecosystem services and, hence, stewardship of global public goods for present and future generations.

AGRICULTURE AND ECOSYSTEM SERVICES

Agriculture is a multi-faceted concept that encompasses a wide range of productive systems. Agriculture can be entirely based on crop, animal, forestry or fishery production, or can involve mixed farming activities from these different sub-sectors. This leads to a huge variety in the types of agro-ecosystems, such as annual crop monocultures, temperate perennial orchards, tropical shifting cultivation systems, smallholder mixed cropping systems, rice production systems, tropical plantations (e.g. oil palm, coffee, tea, cacao, rubber), agroforestry systems, animal-based intense farming system and arid-land pastoral systems (Power, 2010). Potential benefits and/or detriments of agriculture to ecosystem services will be mainly shaped by the typology of the agro-ecosystem, which will be characterised by geographic attributes (country, ecoregion and local conditions of the agro-ecosystem), by the farm size, farming activities and farming management.

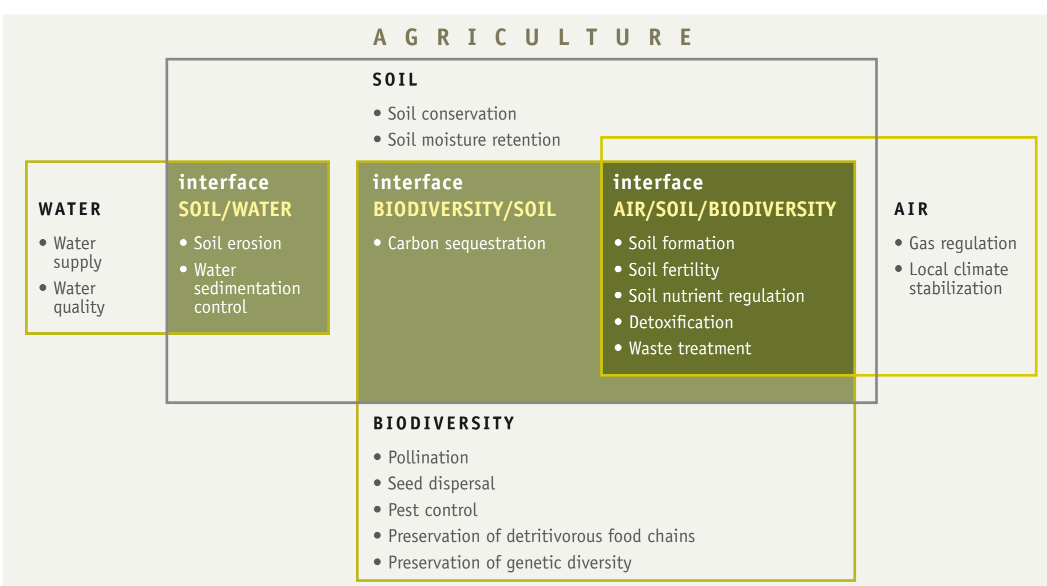
Without any specific in-depth analysis of any type of agro-ecosystems, a general framework of possible relationships between agriculture and ecosystem services is given in Figure 1.

This framework shows how agriculture, while delivering provisioning services (such as water, food, fibres and wood), operates at the intersection of different compartments, such as air, water, soil and biodiversity, let alone a myriad of socio-political compartments. In each of these compartments, agriculture influences key regulating services, such as gas regulation and local climate stabilisation (air compartment); carbon sequestration (at the interface between air, soil, and biodiversity); water supply and water quality (water compartment); soil erosion and water sedimentation control (at the interface between soil and water compartment); soil conservation, soil moisture retention (soil compartment); soil formation, soil fertility, soil nutrient regulation, detoxification and waste treatment (at the interface between soil and biodiversity); pollination, seed dispersal, pest control, preservation of detritivorous food chains, preservation of genetic diversity (biodiversity compartment).

Agriculture influences the habitat quality and consequently the diversity of species not only in each single compartment (air, soil, water and biodiversity), but also at the landscape level. Agriculture modifies natural ecosystems by eliminating and reducing natural habitats, and replacing them with cultivated areas.

Figure 1

Ecosystem services, occurring in different ecological compartments (air, soil, water and biodiversity) and their interfaces, can be enhanced or decreased by agricultural activities



This modification can produce an infinite number of possible spatial configurations of land uses. Sometimes this modification is a result of a historical process and can reflect cultural or aesthetic values. The spatial arrangement of remaining natural habitats and agricultural areas determines different landscape properties, such as the degree of fragmentation of natural habitats, the occurrence of different types of modified vegetation and the interspersion of these different elements in the agricultural matrix. These landscape characteristics will influence, in particular, which wildlife species will be found in the agro-ecosystem and at which population densities.

Relevant ecological scales for regulating services in agriculture

In the previous paragraph, the influence of agriculture on different regulating services has been described without any reference to their spatial scale. However, ecosystem services operate and are regulated at different spatial scales. For example, the control of nitrogen fixation by bacteria occurs in the soil, and soil compaction and soil moisture retention operates at a relatively reduced spatial scale (< 1 km). The regulation of pests and pathogens often occur at the margins of uncultivated areas. Pollination occurs at an ecological scale dependent on the foraging distance of pollinating species. In particular, honeybees and bumblebees usually forage in a range of 3 to 5 km, small bees cover shorter distances of about 1 km and large carpenter bees up to 6 km (Vaissiére *et al.*, 2010). Water quality, water supply, soil erosion and control of sediment load in the freshwater network are often strongly influenced by the management of agricultural practices at the watershed level. Considering larger spatial scales, the overall volume of superficial and subterranean water flows is regulated at the regional level — climate stabilisation, through the regulation of albedo, temperature and rainfall patterns is regulated at the global level.

However, several ecosystem services also occur at multiple spatial scales. For example, the sequestration of carbon dioxide related to the process of photosynthesis occur at the level of a single plant, the crop field, the farm, the landscape, the cultivated watershed, the biome and at the global level. Other ecosystem services are generated at a particular spatial scale, but are regulated at a wider spatial scale. For example, the control of sedimentation load in the freshwater system can be enhanced at the cultivated plot and the farm level, but the reduction of the sedimentation load will probably only be achieved when a significant number of farms in the watershed adopt agronomic practices that limit soil erosion (threshold effect).

In particular, the ecological conditions recorded at the farm level will be always dependent by the conditions found at the landscape level and vice versa. A preserved landscape can enhance the delivery of some ecosystem services at farm level. For example, the pollination of crops on a farm can occur through native pollinators whose main habitat can be found in remaining forest patches of the landscape. On the other hand, agronomic practices can be very successful to preserve soil fertility and soil conservation at farm level, but the disruption of regulating services at landscape level can trigger a major flood washing out the farm and causing the complete loss of topsoil on the farm fields.

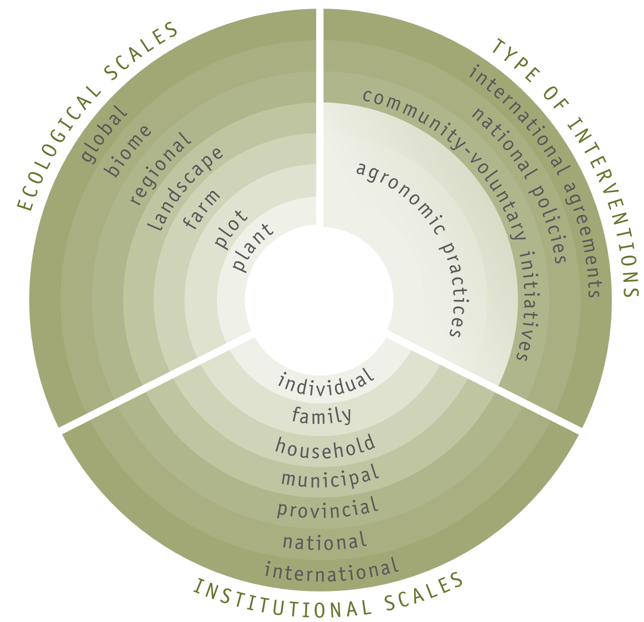
Institutional scales for ecosystem services in agriculture

Given that different ecosystem services are delivered and regulated at multiple spatial scales, this also implies that the agricultural sector is involved in the provision of ecosystem services at different spatial scales. Each spatial scale will be characterised by a given ecological scale, a corresponding institutional scale and an appropriate type of intervention.

The conceptual diagram (Figure 2) shows that at least three different levels of interventions should be considered. The first level considers the agronomic practices that are implemented at the farm level. There are many different agronomic practices that can ideally enhance the delivery of ecosystem services in the air, soil, water and biodiversity compartments. However, the implementation of these agronomic practices often has many drawbacks, especially when dealing with major challenges of poverty alleviation in developing countries (see Viewpoint 1 "Challenges and solutions to the implementation of PES in smallholder farming systems in developing countries"). A second level of intervention refers to practices and interventions that occur at landscape level. These levels can be characterised by different types of management options. As an example, in an intensive monoculture crop agricultural system, if carbon emissions can be reduced at the farm level through the management of agriculture machinery, at the landscape level emission reductions can be achieved by preventing the burning of fallow fields and the conservation of remaining trees (FAO, 2007). The adoption of interventions at the landscape level requires a level of consensus and coordination amongst different stakeholders. This can be achieved by the occurrence of voluntary community initiatives (e.g. Landcare) or by the establishment of regulation that help to coordinate and direct environmental management options. Although voluntary community initiatives and local regulations can initially support the spread and the carrying out of a different way of managing agricultural landscapes, these initiatives are always highly dependent on enabling conditions shaped by market and national policies. The third over-arching level with which agriculture can foster the protection and enhancement of ecosystem services is through sound policies at the national and international levels. Policies and consequent appropriate regulations will give a real push and provide the degree of harmonisation needed to up-scale this process from the local to the landscape, regional, national and global levels.

Ecosystem services are delivered at different spatial scales, requiring different institutional scales and types of interventions

Figure 2
Correspondence between different ecological and institutional scales and possible types of interventions for the preservation and restoration of ecosystem services



AGRI-ENVIRONMENTAL SCHEMES, CERTIFICATION AND PES

The public sector, acting on behalf of and in the interest of civil society, has a key role to play in the protection of ecosystem services as public goods by establishing standards and regulations for their use ('command-and-control' approach), by levelling the market prices and providing positive incentives (see also Chapter 8 "PES within the context of Green Economy").

In the food and agricultural sectors, there have been three main categories of interventions to protect the delivery of ecosystem services: agri-environmental policies, certifications schemes and PES schemes. The distinction between these three categories is not always well defined and there are many nuances by which the categories overlap with each other. By considering the most commonly-accepted definition of PES (Wunder, 2005)[1], several features characterising PES schemes can be identified (see Table 1).

1 PES is a voluntary transaction where a well-defined ecosystem service (ES) is 'bought' by a minimum of one ES beneficiary from a minimum of one ES provider if and only if the ES provider continually secures the ES provision (i.e. with an element of conditionality).

In particular, in the simplest version of a PES scheme, the provider of the ecosystem service is the seller and the beneficiary of the ecosystem service is the buyer. When the public sector enters a PES scheme in a democratic regime the government represents the public will and the interest of the majority of represented stakeholders. In all public PES schemes, there are several conditions that are weakened. In the public PES schemes, the role of the buyer (undertaken by the public sector) becomes distinct from the role of the beneficiary (constituted by a part or the whole of society). In particular, the public sector becomes in charge of setting up the PES scheme, negotiates the terms and conditions, as in the common role of the intermediary, but it also enters into the contractual agreement as the buyer. This means that the direct beneficiaries of the ecosystem services completely delegate the whole PES implementation to the public sector.

Moreover, if the public sector implements a PES scheme using a general budget fund for a service that is provided at a global scale (e.g. carbon sequestration), the whole society will benefit from its provision. On the contrary, if the public sector with the same budget fund implements a PES scheme for an ecosystem service delivered at a more reduced spatial scale (e.g. for the control of soil erosion in a particular watershed), not all the people paying will directly benefit for the provision of that ecosystem service. For this reason, when PES schemes are implemented using funds coming from taxes addressed for the provision of a specific ecosystem service (see Case Study 12 "PES for improved ecosystem water services in Heredia town, Costa Rica"), the profile of the payer matches with that of the beneficiary, as in the original PES condition. Similarly, PES schemes that are implemented with funds coming from donors are also specifically targeted for the delivery of an ecosystem service. Thus, PES implemented with specific funds or specific taxes are closer to the original definition given by Wunder (2005) than PES schemes arising from generic public budget funds.

PES and agri-environmental schemes

According to the OECD definition, agri-environmental schemes are payments that include implicit transfers, such as tax and interest concessions, to farmers to address environmental problems and/or provide ecosystem services (Tarek, 2010).

The main difference between PES and agri-environmental schemes is in the different degree with which payments target specific ecosystem services. Again, the difference, if any, can be subtle and can vary amongst agri-environmental schemes and among implementation in different countries (see also Chapter 2 "Relevance of OECD agri-environmental measures for PES"). The main distinction is that while PES targets ecosystem services, agri-environmental measures usually target specific farming practices. When farming practices are addressed to protect some ecosystem services, the difference between agri-environmental schemes and PES is narrowed.

Table 1
Main characteristics of the PES definition and accomplishments according to different funding schemes

PES is characterised by	Funds coming from a tax labelled for certain ecosystem services	Funds coming from international donors	Funds coming from a general public budget
Payment made for ecosystem service provision	Condition met	Condition met	Payment coming from general funds
Direct benefit of the beneficiary	Condition met	Condition met	Not all people paying for the ecosystem service directly benefit from it
Voluntary nature	Condition weakened	Condition weakened	Condition weakened
Contractual agreement	Condition weakened	Condition weakened	Condition weakened
Negotiated framework	Condition weakened	Condition weakened	Condition weakened
Conditionality of contract which requires continuous provision of the service from the provider	Condition weakened	Condition weakened	Condition weakened

As discussed by Wunder *et al.* (2008), governments may not always be in the best position to identify the need for protection or restoration of ecosystem services. Thus, agri-environmental schemes can have a broader and generic vision and be less tailored to local condition and needs than PES schemes. PES initiatives, on the contrary, being conceived more as a process of negotiation between stakeholders directly involved in the provision and use of ecosystem services, are expected to be characterised by a greater specificity of targets and efficiency of resource allocation. The other elements that can distinguish PES from agri-environmental schemes refer to the degree by which the voluntary nature, the negotiated framework and the conditionality (payment on compliance) of the contractual agreement is implemented. As to the voluntary characteristic of PES schemes, the adhesion of farmers or land subject to agri-environmental schemes under the EU legislation remains voluntary, while the implementation of agri-environmental measures is obligatory for EU member states — making the process only partially voluntary (Tarek, 2010).

Agri-environmental schemes can have a broader generic vision and be less tailored to local conditions and needs than PES schemes

As for the conditionality, which implies compliance to the actual enhancement of the delivery of ecosystem services, agri-environmental schemes often encourage some agronomic activities expected to bring a number of positive externalities without setting a target value for some measurements of ecosystem services delivery targets. There are clearly exceptions. In this respect, the current Farm Bill in United States of America (USA), which provides incentives for improved water and air quality, increased carbon storage and habitat for biodiversity conservation, has a more robust set of requirements than the EU Common Agricultural Policy (CAP) that, on the contrary, is expected to become further strengthened with the next CAP reform due after 2013 (see also Chapter 2 "Relevance of OECD agri-environmental measures for PES"). Thus, the direct linkage between the adoption of a certain agronomic practice and the delivery of ecosystem services can be of varying strength in different agri-environmental policies.

Another difference between agri-environmental schemes and PES schemes is that, in the former, the renewal of the contractual agreement is often linked to other factors, rather than simply addressing compliance. Agri-environmental schemes, as programmes supported by public funds, are particularly vulnerable to budget cuts. These can be influenced by international regulation, adjustments in the trade and market sector, national political instability, political pressures coming from particular lobbies, etc. This can also occur in the implementation of PES schemes from funds coming from a generic budget, but is less likely to occur in the case of funds coming from coming from a tax labelled for certain ecosystem services.

PES and certification schemes

If the features characterising PES schemes are used to compare an ideal PES scheme and certification schemes, it becomes evident that only some certification schemes are actually aimed at the delivery of ecosystem services. In particular, certification schemes usually address only a reduced number of ecosystem services mostly related to biodiversity conservation, bundled ecosystem services or carbon sequestration. For example, bird-friendly coffee[2] certification ensures biodiversity conservation particularly related to bird species and their healthy forest habitats. Rainforest Alliance[3] certifies farms that produce coffee under rigorous criteria that refer to a bundle of ecosystem services, including reduced water use and water pollution, reduced soil erosion, protection of wildlife habitat and improved working conditions for farmers. In this case, as per PES definition, there is a clear identification of the ecosystem service supported by the initiative.

2 http://nationalzoo.si.edu/scbi/migratorybirds/coffee/

3 http://www.rainforest-alliance.org/agriculture/crops/coffee

However, in certification schemes, the buyer of the service (in this case, the consumer) does not make direct use of this service, but usually pays for an option value[4] or a bequest value[5].

Although consumers can voluntary decide to buy a certified product and interrupt this consumption at any time, they are not bound by any contractual agreement, nor can they negotiate the 'right price' for that particular product. Moreover, if the consumer withdraws from buying the certified product, this is more than likely linked to market factors, rather than by conditionality related to the effective provision of the ecosystem service. The certification refers to the standard itself, while verification is the process whether a project or activity meets the targeted standard. As long as the product is on the shelf, it is assumed that the compliance of the standard for which the product is certified is met. Thus, certification schemes have some similarities with PES schemes, but are not specifically PES schemes and, as previously highlighted, they exist only for a few ecosystem services. In some cases, certification schemes are used in conjunction with cap-and-trade schemes, for example, in the certification of carbon offsets (see also Chapter 7 "Enabling conditions and complementary legislative tools for PES"). In other cases, certification schemes and PES schemes have been implemented in the same study area to target different needs in the ecosystem (see Case Study 1 "PES and eco-certification in the Kapingazi watershed, Kenya"). It has also been suggested to combine certification and PES schemes in a 'landscape labelling approach', with a view to increase the income-generating options of PES schemes, strengthen the social impact of PES schemes and increase their potential to be pro-poor (see also Chapter 6 "Landscape labelling approaches to PES: Bundling services, products and stewards").

Certification schemes usually only address ecosystem services related to biodiversity, bundled services or carbon sequestration

PES SCHEMES IN AGRICULTURE

PES projects are usually classified as PES for water, carbon sequestration, biodiversity and landscape beauty or as PES for bundled services (Landell-Mills and Porras, 2002), but there are no PES schemes that are classified as PES for agriculture. Why is this? Clearly, there are PES schemes in agriculture, but in some cases, as illustrated above, some of these initiatives are commonly found as agricultural policies or agri-environmental schemes. In other cases, some PES schemes, while strongly related to agriculture, appear to be classified as PES for water, landscape beauty, carbon sequestration and biodiversity.

4 The knowledge that ecosystem services will be available for one's own use in future (option use).

5 The assurance that ecosystem services will be passed on to descendants (bequest value).

Agriculture can be an entry-point in PES, as agriculture practices are a critical factor in conveying services or disservices

Agriculture is likely to be an entry-point in PES, as agricultural practices are a critical factor in conveying services or disservices. Moreover, different stakeholders are often involved in the provision and utilisation of ecosystem services and there are divergent economic and social interests, which entails some negotiation in order to avoid conflicts in the management, restoration or amelioration of ecosystem services' provision. To better illustrate this point, some examples of PES schemes are provided in the following section in which the agriculture is an entry point for the restoration of soil loss and erosion, water quality and supply, landscape beauty, carbon sequestration and biodiversity.

PES in agriculture and soil loss and soil erosion

A great number of PES schemes in developing countries are focused on the reduction of soil loss and soil erosion. For example, the silvo-pastoral PES schemes applied in Colombia, Costa Rica and Nicaragua were aimed at soil conservation by planting high densities of trees and shrubs in pastures, by feeding livestock on fodder, rather than natural vegetation, and by creating windscreens with shrubs and fast-growing trees (Pagiola *et al.*, 2007). Soil erosion is often caused by farming activities on sloping terrains that are carried out without using physical and vegetation barriers to control the loss of soil. In the PES scheme implemented in Sumberjaya (Indonesia), several physical barriers, such as sediment/litter pits, dead-end trenches and drainage ditches, were associated with the coffee plantations, as well as conservation of remaining forest patches and multi-strata coffee gardens (see Case Study 13 "PES and multi-strata coffee gardens in Sumberjaya, Indonesia"). In the PES project in the Uluguru Mountains (Tanzania), the use of bench terraces and traditional terracing (*fanya juu* and *fanya chini*[6]) was combined with the protection of different levels of vegetation (grass strips and tree cover related to reforestation of agroforestry activities) together with the adoption of agronomic measures that limit soil erosion (see Case Study 3 "PES in the Ruvu watershed of the Uluguru mountains, Tanzania").

A similar approach, involving traditional terracing and other soil conservation efforts, is presently under evaluation to be shortly adopted in a PES scheme in the Kapingazi watershed (Kenya) where the watershed services are hampered by intense deforestation, by the large coffee cultivation carried out without soil and water conservation practices, and by intense

6 Fanya is a traditional terracing technique whereby a ditch is made along the contour or on a gentle lateral gradient. Soil is thrown on the upper side of the ditch (fanya juu) or on the lower side of the ditch (fanya chini) to form the bund, which is often stabilised by planting fodder grass.

use of the riparian buffer area along the Kapingazi River for food and fodder production (see Case Study 1 "PES and Eco-certification in the Kapingazi Watershed, Kenya").

In the watershed of Kulekhani (Nepal), forests were traditionally managed by local communities for firewood, to collect fodder for animals and to raise free-roaming cattle. In the early 1960s, the nationalisation policy led to major deforestation in Kulekhani. Participatory watershed conservation programmes were subsequently implemented to control the high rate of soil erosion and the sedimentation rate in the Kulekhani reservoir measures. Adopted measures included: creation of control gullies, building sediment-traps and reforesting steep slopes (see Case Study 9 "Community-based PES for forest preservation and sediment control in Kulekhani, Nepal").

In all these four described cases, an initial deforestation carried out on the steep slope of the watershed and the adoption of agricultural activities, not particularly suited for water and soil conservation, have aggravated the natural soil erosion process with the resultant increased sediment load in the freshwater system. As a consequence, the disruption of watershed services in these areas has affected the functioning of hydroelectric power plants, which are located in the lower parts of these watersheds. Thus, although these PES schemes are normally classified as PES for water, agricultural activities are an entry point not only as an important driving factor in the establishment of the problem, but also as a key factor in the restoration of the watershed services.

Other PES schemes for watershed services do not implement physical and structural barriers against soil loss or improved agronomic practices, but focus specifically on afforestation programmes and conservation of the remaining forests.

In the case of the Nyando and Yala basins (Kenya), an increased rate of sediment load has been caused by the high deforestation rate and the production of cash crops (mainly tea) cultivated in the middle zone of each of these two watersheds. The sedimentation load coming from these two watersheds aggravates the ecological degradation and major eutrophication issue of Lake Victoria. Thus, a PES scheme has been implemented to launch an afforestation programme that seeks to engage farmers in the choice of the preferred tree species to plant in the two watersheds (see Case Study 7 "Farmers' perspectives on planting trees on their farms, in the Lake Victoria Basin, Kenya").

The conversion of natural forests and native Andean alpine grass (*pàramos*) to annual crops and pasture is the driver for a PES scheme that involves a farmer cooperative of 27 households as sellers of the watershed services and the citizens the town of Pimampiro (Ecuador) as the buyers (see Case Study 6 "PES for improved ecosystem water services in Pimampiro town, Ecuador"). Similarly to the PES scheme in Pimampiro (Ecuador) is one that is financed by the citizens of the town of Heredia (Costa Rica) that aims to secure water quality and supply by rewarding private landowners to protect existing forest patches in the upper parts of five watersheds surrounding the town (see Case Study 12 "PES for improved ecosystem water services in Heredia town, Costa Rica").

In at least one situation, agriculture was considered the major cause of ecosystem disservice and it was evaluated that, in such a highly degraded agro-ecosystem, further agricultural production would have been incompatible with the restoration of regulating services in the watershed, such as the reduction of sedimentation rate and flood control. In fact, in the Yangtze River Watershed (China), intensive farming on sloping terrains has certainly contributed to massive soil erosion and the subsequent large floods of the Yangtze River in 1999. The Government of China implemented a national PES scheme, known as the Sloping Land Conversion Program, to reward farmers to abandon their farming activities in the upper area of the watershed and to restore forests (Scherr *et al.*, 2006).

PES in agriculture and landscape beauty

Another category of PES schemes seeks to protect landscape beauty and some of these also related to agriculture in particular when the landscape aesthetics involved ‘rural amenities’ (FAO, 2007). Conversely, some agricultural landscapes, besides delivering provisioning services, can also deliver cultural services related to the pleasure that people gain in seeing, visiting or just knowing about the existence of these landscapes.

An example is agritourism where traditional agriculture activities have conferred some distinct features to the landscape that is appreciated for its historical value, attractive countryside and distinct agricultural products. For example, a PES scheme supported by the EU Common Agricultural Policy (CAP) rewards farmers to conserve a region of 6 000 hectares in Amfissa (Greece) where 150-year-old olive trees are grown (Vakrou, 2010). In Switzerland, Article 104 of the Federal Constitution of the Swiss Confederation clearly defines that part of the role of agriculture is also the maintenance of rural employment and cultural heritage. Areas eligible for ecological compensation include semi-natural habitats, such as extensively cultivated meadows and pastures, hedges and woods, traditional orchards, ponds and stonewalls. Farmers receive an ecological compensation for extensive meadow-land, natural field margins, permanent flowery meadows (mowing of grass has to be done at specific times to allow flowers to turn to seed) and rotated fields, hedges, wooded riverbanks and fruit trees (SFSO, 2007; Vermont, 2005). This is a case of a PES-like regulation as farmers receive annual payments in return for the adoption of specific agronomic practices on their land, but they are not bound by a contractual agreement. Farmers enrol and receive their compensation from the canton authorities, who in turn ask for federal funding.

Agricultural landscapes deliver cultural services related to the pleasure in visiting or knowing about beautiful rural landscapes

Another example of the protection agricultural scenic beauty is in the eastern part of The Netherlands where the landscape is characterised by a unique mosaic of small-size field plots which together creates a suggestive pattern appreciated by residents, as well as the many tourists attracted to this region. Therefore, the Dutch Government recently established a 'landscape fund' to reward farmers for the forgone income opportunities related to the preservation of the characteristics of this landscape (Almasi, 2005).

PES in agriculture and carbon sequestration

Agriculture also offers many possibilities to enhance carbon sequestration both in the soil and in perennial plants, as well as reductions in carbon and methane emissions (FAO, 2007). Carbon sequestration through perennial plants can be achieved with various types of conversion of agricultural land ranging from afforestation (from barren land to trees), to agroforestry (from crops to crops mixed with trees), to reforestation (from logged forest to replanted forest) and forest conservation.

An example of afforestation that encompassed the complete conversion of barren land, which was discontinuously used as a grazing area, into a 4 000 ha reforested area for carbon sequestration has been implemented in the Pearl River Basin in the Guangxi Zhuang Autonomous Region of China (Chen, 2010).

Examples of carbon sequestration through agroforestry are being implemented by Plan Vivo. This non-profit organization promotes a mixed system in which agricultural production is combined with carbon sequestration according to a 'plan vivo', designed at the farm level with a strong participatory approach that brings the farmers to decide on and draw the interspersion of cultivated plots and planted trees. The reduction of carbon emissions gained with this type of agricultural production are independently assessed and generate Plan Vivo Certificates, which are sold as carbon offsets for the conservation of ecosystems and poverty reduction of landholders (see Case Study 10 "Plan Vivo: A voluntary carbon sequestration PES scheme in Bushenyi district, Uganda"). A similar approach has been promoted by the joint initiative (SCC-Vi) of the Swedish Cooperative Centre (SCC) and Vi Agroforestry Programme (Vi) in Karawage district (Tanzania). This PES scheme remunerates small-scale farmers for carbon sequestration obtained through agroforestry and sells carbon off-sets to the voluntary carbon market (see Case Study 11 "PES and the Kagera Transboundary Agro-ecosystems Management Project, Eastern Africa").

Carbon sequestration can be achieved from the afforestation of abandoned lands, agroforestry, reforestation and forest conservation

Carbon credits can also come from the reforestation of areas of marginal farmland that are located in key locations to restore the ecological connectivity of the landscape. An example is the project bring promoted by PowerTree Carbon Company LLC[7], a multi-million dollar company

7 http://www.powertreecarboncompany.com

constituted by a voluntary consortium of 25 leading American electric power companies or their affiliates that aim to mitigate climate change through forest restoration in the Lower Mississippi Alluvial Valley (LMAV) in Louisiana. The project involves almost 4 000 acres that were replanted in 2004-2005 with 1.2 million trees. The forest restoration is expected to capture about 1.4 million tonnes of carbon dioxide from the atmosphere and, at the same time, recreate critical habitat for wildlife. The PowerTree Carbon Company LLC retains the rights to all emission reductions associated with the project and distributes the carbon offsets among its 25 member companies.

Agriculture also has a high potential for carbon sequestration in soils

There are numerous examples of carbon sequestration projects aimed at the protection of native forests (Landell-Mills and Porras, 2002). In tropical areas, the conservation of native forest patches for carbon sequestration in agricultural landscapes often has high opportunity costs considering the possible revenues from timber extraction and conversion of the patches for other land uses. As an example, in Sumatra (Indonesia), a rough evaluation of forgone opportunity costs, which includes also the exploitation of timber species, ranges from USD 8.50 for community-based forest management, to almost USD 10 for oil palm, and nearly USD 16 per tonne for intensified rubber agroforests (Tomlich *et al.*, 2002). Forgone opportunity costs and potential benefits from ecosystem service preservation usually have a high degree of spatial variability (Naidoo and Ricketts, 2006; Wendland *et al.*, 2010) and should be always assessed through spatially explicit cost-benefit analysis (see also Chapter 4 "Cost-effective targeting of PES"). Although generalisations are not possible, the evaluation made by Tomlich *et al.* (2002) suggests that international carbon markets, which on average rewards a price of USD 25 per tonne of carbon, have the potential to shift incentives from forest conversion to conservation.

In summary, when rural landholders participate in a carbon sequestration schemes, they can do so by providing available land for others to plant forests, by preserving existing forest patches on their land or by converting their crop fields into agroforestry systems. In addition, agriculture also has a high potential for carbon sequestration in soils through minimal mechanical soil disturbance (zero tillage and direct seedling), maintenance of the carbon-rich organic matter layer of soil, rotation and sequencing and associations of crops and tree cultivation, improved grassland management and controlled grazing (FAO, 2007; FAO, 2010). Since the early 2000s, farmers in Australia and the USA have been advocating for the recognition of 'carbon farming'[8] and 'carbon grazing activities'[9], even though there is not yet an active, functioning carbon market for carbon sequestration in soils.

8 http://soilcarboncoalition.org, http://carbonfarmersofamerica.com and http://www.carbonfarmersofaustralia.com.au

9 http://www.carbongrazing.com.au

PES in agriculture and biodiversity conservation

In agriculture, PES can enhance biodiversity in different ways: by protecting patches of native habitats, by running agricultural activities which provides suitable ecological conditions for species' occurrence in the soil, water and air compartments, and by providing adequate connectivity for wildlife amongst natural habitats. Thus, biodiversity conservation implies a triple action, which includes conservation, monitoring and sound environmental management at the farm level, but also at the landscape level.

An example of PES schemes for biodiversity which target specific management practices is found in the district of Bungo (Indonesia). Bungo is the third most important Indonesian province for rubber production, where traditional rubber agroforestry practices (in jungle rubber gardens) still survive next to wide expanses of rubber plantations. Rubber jungles are created by having a multi-generational rubber tree agrosystem with trees at different growing stages with a structure resembling the native forest. The biodiversity of trees, ferns and bird species in jungle rubber gardens is quite high and often comparable with that of native forest patches, although biodiversity is clearly expected to vary locally according to the development stages of the rubber jungle, rubber tree densities, management practices and proximity to remaining native forest patches. PES schemes seem promising to incentivise rubber production through traditional rubber jungles and reward farmers for contributing to biodiversity conservation (see Case Study 4 "PES and rubber agroforestry in Bungo district, Indonesia").

A different example, in which PES schemes have been targeted to restore the landscape connectivity and favour wildlife movement, is found in Costa Rica in the San Juan-La Selva Biological Corridor. PES contracts were made to cover 729 km² of the corridor, which extends from the Braulio Carrillo National Park (in Costa Rica) to the Indio Maìs Biological Reserve (in Nicaragua) and is constituted by an aggregation of private properties in a landscape mosaic of privately-owned forests, pastures for cattle grazing, sugarcane, bananas and pineapple crops (Morse *et al.*, 2009).

From PES to remuneration for positive externalities in the agriculture and food sectors

Although PES approaches are particularly suitable to promote the conservation and enhancement of ecosystem services in rural areas, their role has been greatly underestimated. The potential of PES in rural areas is related to the possibility of being able to trigger agronomic practices which are able to protect the proper functioning of ecosystem services and, thus, ensure the productive basis of long-term food security for local communities. PES schemes, characterised by a strong participatory approach, promote dialogue amongst different stakeholders, as well as negotiation amongst the various needs and perspectives until an agreement is reached and a PES contract is signed. The participation and community agreement/cohesion on decisions related to the local management of natural resources and production activities is a major driver in the long-term preservation of natural capital (see also Chapter 5 "Social and cultural drivers behind the success of PES").

PES schemes have an added value over agri-environmental schemes, as PES initiatives have the capacity to engage previously uninvolved stakeholders (beneficiaries of ecosystem services), including private enterprises. This results in better mapping of the social capital and in the potential to increase the financial resources to support initiatives aimed at sustainable development. Furthermore, PES schemes are conceived as payments released upon 'compliance' with the agreed actions (land use and agronomic practices) aimed at the preservation and restoration of ecosystem services. This adds to PES schemes an important component of monitoring activities on the status of ecosystem services. Despite this high potential, there are several misconceptions that have concurred to hide the potential of PES in agriculture. The first misunderstanding relates to the fragility of PES schemes to deal with the high complexity of agro-ecosystems. Several agro-ecosystems, especially in developing countries, can be characterised by a social network where strong social inequalities are found and where conflicting needs for the use of natural resources can be higher than less populated situations where production activities are scarce. If the criteria to adopt a PES scheme simply reflect an economic efficiency criteria (see also Chapter 3 "Opportunities and gaps in PES implementation and key areas for further investigation"), it is clear that implementing PES for agro-ecosystem services can be considered as a very challenging task. On the contrary, if the social dimension of PES schemes is fully integrated into PES design, PES can actually be considered as a viable tool for achieving a collective vision that also considers poverty alleviation.

The potential of PES in rural areas is in its ability to trigger agronomic practices that ensure long-term food security

A second limitation refers to the ability of PES schemes to obtain real participation of farmers in disadvantaged situations (Pagiola *et al.*, 2005). As recommended by several authors, PES schemes can be designed in such a way as to encourage genuine participation and stakeholders' engagements. However, the true strength of PES lies in trust-building, which requires time (Wunder, 2007). One of the major weaknesses of short-term programmes is that PES' usual 3-5-year time frame does not allow a detailed analysis of farmers' needs, nor the opportunities and constraints faced in their farm management. If there is no genuine participation of farmers, if the interests of the farmers are not put first and if farmers are not seen as part of the solution, as opposed to the actors creating the problem, PES schemes are unlikely to achieve any long-term improvement in the conditions of the agro-ecosystem (Hellis and Schrader, 2003).

A third commonly perceived limitation refers to the difficulty in measuring the provision of ecosystem services at the farm level. As a consequence, the payment schemes in PES have generally been based on the adoption of practices, rather than on achieved performance of ecosystem services delivery at the farm level. This can be considered as a limitation, especially when facing the need to demonstrate the additionality of contracting several or specific farms at different locations. In reality, the truth is that payment will ultimately be based on a negotiation process, rather than on a simple crude scientific quantification of ecosystem services at the farm level (Tognetti and Johnson, 2008).

What is highly needed though is scientific information that measures, in a quantitative way, the impact of incremental changes in some agronomic practices on ecological production functions (Tallis *et al.*, 2008). The knowledge of the ecological limits below which a sustainable use of agro-ecosystems can be carried out will be key information to avoid overexploitation and ecosystem services disruption.

A fourth limitation on the development of PES in agriculture is the strong interrelationship between different ecosystem services (Bennett *et al.*, 2009). This has probably diverted the attention by only focusing on a single ecosystem service, such as water, carbon sequestration, biodiversity and landscape beauty or bundling ecosystem services only as a sale mechanism (see Case Study 5 “PES in Costa Rica”).

However, a new generation of PES in agriculture could seek the potential of a specific set of ecosystem services that can be simultaneously enhanced through appropriate agricultural practices (bundling of ecosystem services in agriculture). In this new vision, a PES labelled as PES in agriculture would be aimed at ensuring the long-term delivery of food security, a condition that will be fulfilled only when at least the subset of ecosystem services that are particularly influenced by agricultural activities are managed under sustainable and ecological criteria. In particular, a new generation of PES in agriculture for food security should:

- **Be driven by a strong participatory approach**;
- According to a collective vision, **be implemented at community level**;
- Seek to promote a model of production based on the ecological **carrying capacity of agro-ecosystems**;
- **Consider a bundle of ecosystem services**, rather than a single one.

There is always the tendency of falling into the belief that there is a panacea, a single solution that will be able to solve complex problems. When PES was first conceived, it was believed that the market forces alone, applied to the simple structure of a PES mechanism would automatically deliver the desired outcomes. However, if there is one lesson to be learned that PES experience has been advocating, it is that it is crucial to design tools, including PES, that reflect the complexity of reality, that give voices to the plurality of stakeholders’ perspectives and that adapt to the multi-faceted challenges of sustainability.

REFERENCES

Almasi, A. 2005. *Some issues and examples of environmental services and financing for the protection and sustainable use of water-related ecosystems in The Netherlands, a contribution of the Ministry of Agriculture, Nature and Food Quality*. Seminar on Environmental Services and Financing for the Protection and Sustainable Use of Ecosystems, Geneva, 10–11 October 2005.

Bennett, E.M., Peterson, G.D. & Gordon, L.J. 2009. Understanding relationships amongst multiple ecosystem services. *Ecology Letters*, 12: 1394–1404.

Chen, C. 2010. Using barren land for afforestation: Assessing the results of the first registered CDM forestry project. *Mountain Forum Bulletin*, 10(1):40–42.

FAO. 2007. *The state of food and agriculture 2007: Paying farmers for environmental services*. FAO Agriculture Series, No. 38. Rome, Food and Agriculture Organization of the United Nations.

FAO. 2010. *"Climate-smart" agriculture policies, practices and financing for food security, adaptation and mitigation*. Rome, Food and Agriculture Organization of the United Nations (available at http://www.fao.org/docrep/013/i1881e/i1881e00.pdf).

Hellis, J. & Scrader, K. 2003. The case against direct incentives and the search for alternative approaches to better land management in Central America. *Agriculture Ecosystem and Environment*, 99: 61–81.

Landell-Mills, N. & Porras, I. 2002. *Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor*. Instruments for Sustainable Private Sector Forestry Series. London, International Institute for Environment and Development (IIED) (available at http://www.iied.org/pubs/display.php?o=9066IIED).

MEA. 2005. *Millennium ecosystem assessment. Our human planet: Summary for decision-makers*. Washington, D.C., Island Press.

Morse, W.C., Schedlbauer, J.L., Sesnie, S. E., Finegan, B., Harvey, C.A., Hollenhorst, S.J., Kavanagh, K.L., Stoian, D. & Wulfhorst, J.D. 2009. Consequences of environmental service payments for forest retention and recruitment in a Costa Rican biological corridor. *Ecology and Society*, 14(1): 23.

Naidoo, R. & Ricketts, T.H. 2006. Mapping the economic costs and benefits of conservation. *PLOS Biology*, 4(11): e360.

Pagiola, S., Arcenas, A. & Platais, G. 2005. Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. *World Development*, 33(2): 237–253.

Pagiola, S., Ramirez, E., Gobbi, J., De Haan, C., Ibrahim, M., Murgueitio, E. & Ruiz, J.P. 2007. Paying for the environmental services of silvopastoral practices in Nicaragua. *Ecological Economics*, 64: 374–385.

Power, A.G. 2010. Ecosystem services and agriculture: tradeoffs and synergies. *Philosophical Transaction of the Royal Society* B, 365: 2959–2971.

Scherr, S., Bennett, M., Loughney, M. & Canby, K. 2006. *Developing future ecosystem service payments in China: Lessons learned from international experience*. A Report Prepared for the China Council for International Cooperation on Environment and Development (CCICED) Taskforce on Ecocompensation. Washington, D.C., Forest Trends/Ecoagriculture Partners/Peking University.

SFSO (Swiss Federal Statistical Office). 2007. *Ecological Compensation Areas, basic data from biodiversity monitoring BDM*. Switzerland, Swiss Federal Statistical Office, Federal Office for the Environment.

Tallis, H., Kareiva, P., Marvier, M. & Chang, A. 2008. An ecosystem services framework to support both practical conservation and economic development. *Proceedings of the National Academy of Sciences*, 105(28): 9457–9464.

Tarek, A. 2010. *Overview on the agri-environmental policy in Europe as a system for payment for environmental services* (available at http://www.scribd.com/tarek_amin).

Tognetti, S.S. & Johnson, N. 2008. *Ecosystem services from improved soil and water management: Creating a return from their multiple benefits*. Prepared for the CGIAR Challenge Program on Water and Food, "Water and People in Catchments" Research Theme (available at http://gisweb.ciat.cgiar.org/wcp/download/PES_Workshop/Tognetti_Johnson_PES_SWC.pdf).

Tomich, T.P., de Foresta, H., Dennis, R., Ketterings, Q., Murdiyarso, D., Palm, C., Stolle, F., Suyanto & Van Noordwijk, M. 2002. Carbon offsets for conservation and development in Indonesia? *American Journal of Alternative Agriculture*, 17(3): 125–137.

UNCED (United Nations Conference on Environment and Development). 1992. *Agenda 21 - Rio Declaration on Environment and Development*. Chapter 14. Rio de Janeiro, Brazil.

Vaissiére, B.E, Freitas, B.M. & Gemmill-Herren, B. 2010. *Development of tools and methods for conservation and management of pollination services for sustainable agriculture*. FAO/IFAD project report.

Vakrou, A. 2010. *Payments for ecosystem services (PES): Experiences in the EU*. Presentation given during OECD WGEAB Workshop, 25 March 2010, Paris (available at http://www.oecd.org/env/biodiversity).

Vermont, S. 2005. *National report of Switzerland on environmental services and financing the protection and sustainable use of water related ecosystems*. Seminar on Environmental Services and Financing for the Protection and Sustainable Use of Ecosystems, 10–11 October 2005, Geneva, Switzerland.

WBCSD & IUCN. 2008. *Agricultural ecosystems – Facts and trends* (available at http://www.wbcsd.org/DocRoot/hecbd2TCBtPqRBOGXoi2/AgriculturalEcosystems.pdf).

Wendland, K. J., Honzak, M., Portela, R., Vitale, B., Rubinoff, S. & Randrianarisoa, J. 2010. Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar. *Ecological Economics*, 69(11): 2093–2107.

World Bank. 2009. *Agriculture: An engine for growth and poverty reduction*. The International Development Association (available at http://siteresources.worldbank.org/IDA/Resources/IDA–Agriculture.pdf).

Wunder, S. 2005. *Payment for environmental services: Some nuts and bolts*. Jakarta, Centre for International Forestry Research (CIFOR).

Wunder, S. 2007. The efficiency of payments for environmental services in tropical conservation. *Conservation Biology*, 12: 48–58.

Wunder, S., Engel, S. & Pagiola, S. 2008. Taking stock: A comparative analysis of payment for environmental services programs in developed and developing countries. *Ecological Economics*, 65: 834–852.

CHALLENGES AND SOLUTIONS TO THE IMPLEMENTATION OF PES IN SMALLHOLDER FARMING SYSTEMS IN DEVELOPING COUNTRIES

Barbara Gemmill-Herren
Food and Agriculture Organization of the United Nations, Rome, Italy

The resilience that is required to ensure food security will come from building agricultural systems that are more diverse, adopt ecosystem approaches and are more efficient in making use of inputs (FAO, 2010; IAASTD, 2008; Pinstrup-Anderson, 2010). Increasingly, it is recognised that smallholder systems can be more efficient than large-scale farms (Altieri *et al*., 1998; Lele *et al*., 2010; Pinghali, 2010). Smallholder farmers in developing countries are the appropriate focus for suggesting interventions for a more resilient, pro-poor agriculture in that these farmers cultivate about 85 percent of all agricultural lands and all suffer in varying degrees from similar problems associated with low yields and unpredictable exposure to markets (Morton, 2007). While they have the greatest need for yield increases, they also experience the greatest challenges in securing them. The potential for yield increases will primarily come from good agronomic practices applied to achieve maximum benefit from the efficient use of natural resources and ecosystem services. As such, the most critical inputs are knowledge and capacity-building; inputs that are presently poorly supported by the low levels of investment in extension services in many developing countries.

The suite of ecosystem services that have received the most attention under PES schemes have tended to those for which buyers are most evident: carbon sequestration, watershed functions and biodiversity conservation (FAO, 2007). The subset of ecosystem services that directly address *in-situ* sustainability of agricultural production — genetic resources, erosion regulation, water purification, pest regulation, pollination, disease regulation — has yet to receive commensurate attention. Yet, it is these very services that will ensure that agricultural production is carried out in a sustainable manner both in the present and the future, with food security being given central attention. Most of these services are showing worrisome and declining trends (MEA, 2005).

If it can be accepted that sustainability in agriculture is a global public good, it is worthwhile addressing exactly what practices may be useful to preserve and increase both food production and the delivery of ecosystem services in smallholder farming systems in developing countries. Those agronomic practices that are believed to have an impact on ecosystem services directly related to food production can be grouped into five main categories:

a. Increasing and diversifying plantings at the farm level (use of crop margins, rotations, farm edges, fallow lands or strips within cultivated areas);
b. Applying soil and water conservation practices at the farm level;
c. Increasing efficiency in the application of external inputs at the farm level;
d. Making greater use of local agrobiodiversity;
e. Improving the management of uncultivated areas in farming landscapes.

It is not always self-evident that these practices immediately benefit farmers; for resource-poor farmers, working under conditions of insecure tenure or labour shortages, for instance, it may be more economical to mine the soil than to practice soil conservation. Challenges to securing these practices in smallholder agriculture in the absence of incentive schemes are described below:

a. **Increasing and diversifying plantings on-farm:** Given the extremely small size of most smallholder farm parcels, it is highly unlikely that farmers in developing countries are able to introduce set-aside land for biodiversity or allocate portions of their land to fallow or non-productive plantings, so long as the incomes and livelihoods they receive from farming are so marginal. Nonetheless, there is considerable evidence that on-farm diversity (through relay and intercropping, agroforestry and even selective weed control) delivers substantial services with respect to functions, such as pollination and pest control.


© FAO/J. M. Micaud

Previous page:
↖ Mixed cropping is practiced on terraces in Uttarakhand, India, as an important soil and water conservation tool.

Current pages (from left to right):
→ Limiting agricultural inputs through organic farming in Fulbari, Nepal, for the maintenance of several ecosystem services.
→ Rice is the most important crop in Sierra Leone and the establishment of resilient agricultural systems for successful rice inter-cropping requires proper training and support.
→ Training of farmers in rice fields near Lemakaya, Indonesia, for increasing efficiency in the application of external inputs.

b. **Applying soil and water conservation practices:** There is a long history of the successes and failures of soil and water conservation practices adopted in smallholder farming systems. Most of the challenges relate to the additional time, labour and material costs that cannot easily be borne by subsistence and small-scale farmers. Where soil conservation practices require that strips of land are removed from cultivation, the same constraints as with increasing and diversifying plantings occur.

c. **Increasing efficiency in the application of external inputs:** This is expected to be an area where win-win solutions might be more readily possible, in that increased efficiency of inputs could lead both to reduced costs and/or increased yields. However, small farm sizes often make farmers extremely risk-averse and inclined to overuse, rather than reduce, inputs, such as pesticides.

d. **Making greater use of local agrobiodiversity:** This particular cluster of interventions includes those practices that many smallholder farmers already apply in saving and selecting their own seeds and in keeping small fields with diverse cropping patterns that tend to favour natural enemies and pollinators. These practices are at imminent risk of disappearing under agricultural intensification.

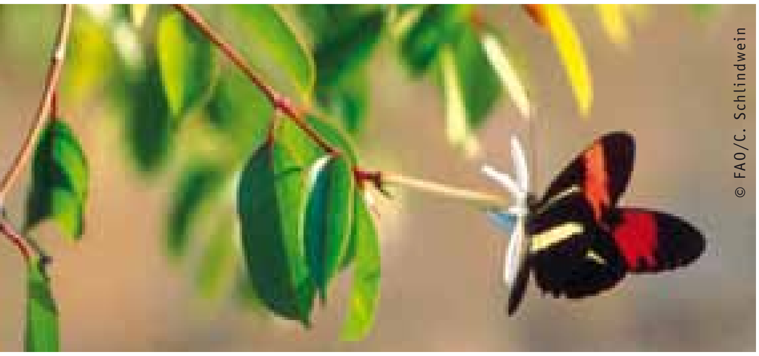
e. **Improving the management of uncultivated areas in farming landscapes:** Farming communities generally do not have management control over the public areas of land or larger landscapes in which their farms are situated. Yet, many ecosystem services are generated at a landscape scale. Pollination services is a flagship example of a positive externality, since beekeepers — or those who encourage native bee populations — do not often get paid for the services they provide to other farmers and the bees they encourage cannot be

© B. G. Herren

© USDA/J. Cane

restrained from providing the service of pollination beyond the boundaries of any one farm. Small patches of forest and even roadside verges with flowering plants can be important habitats for pollinators in a cultivated landscape. Another example is the control of the newly-introduced fruit-fly (*Batrocera invadens*) in Africa, which requires management not on a field or farm scale, but on a 'pest-shed' scale, using measures to manage the pest on all vegetation within a landscape.

The challenges identified above, on the path to more resilient and sustainable agricultural systems, could be addressed by strategic incentive measures, including PES schemes, and it should be recognised that sustainable agriculture in and of itself is a benefit ultimately for the global good.



© FAO/C. Schlindwein

Examples of pollinators species. From left to right:

→ The Asiatic honeybee (*Apis cerana*) is indigenous to Asia from Afghanistan and Japan, and from Russia and China in the north to southern Indonesia.

→ The squash bee (*Peponapis pruinosa*) is found throughout the USA, except in the northwest.

→ The longwing butterfly (*Heliconius* spp.) is spread from the southern United States throughout Central and South America and the West Indies, with the greatest diversity of species in the Amazon Basin.

REFERENCES

Altieri, M., Rosset, P. & Thrupp, L. 1998. *The potential of agroecology to combat hunger in the developing world*. Policy Brief. Oakland, California, Institute for Food and Development Policy.

FAO. 2007. *The state of food and agriculture 2007: Paying farmers for environmental services*. Rome, Food and Agriculture Organization of the United Nations.

FAO. 2010. *"Climate-smart" agriculture: Polices, practices and financing for food security, adaptation and mitigation*. Rome, Food and Agriculture Organization of the United Nations.

IAASTD (International Assessment of Agricultural Knowledge, Science and Technology for Development). 2008. *Executive summary of the synthesis report and summary for decision makers of the global report, approved in detail by governments attending the IAASTD Intergovernmental Plenary in Johannesburg, April 2008* (available at http://www.iaastd.com).

Lele, U., Pretty, J., Terry, E., Trigo, E. & Klousiam, M. (2010) *Transforming Agricultural Research for Development*. GCARD Background Paper. Montpellier, France, Global Conferences on Agricultural Research for Development (GCARD).

MEA. 2005. *Ecosystems and human well-being: Our human planet: Summary for decision makers*. Washington, D.C., Island Press.

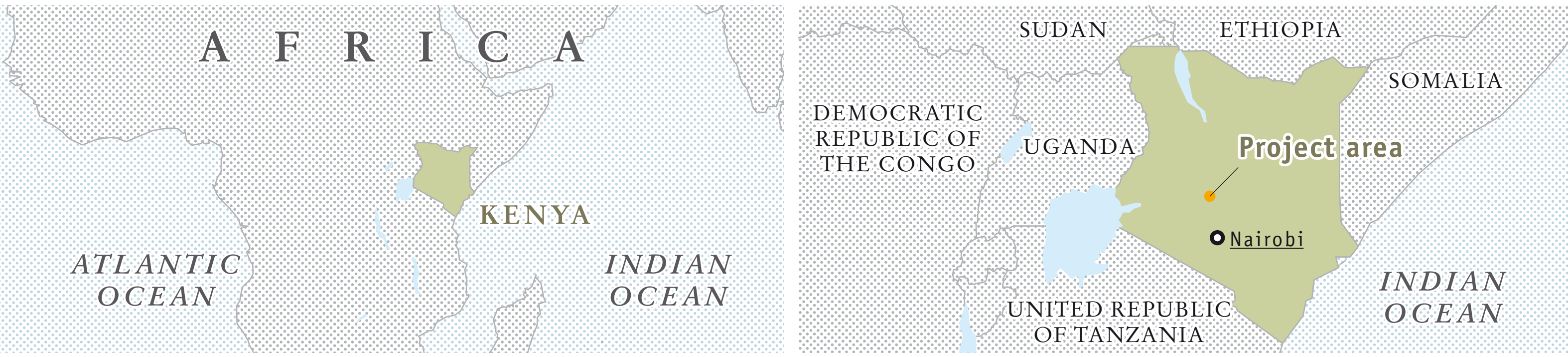
Morton, J.F. 2007. The impact of climate change on smallholder and subsistence agriculture *Proceedings of the National Academy of Sciences*, 104(50): 19680–19685.

Pinghali, P. 2010. *Prabhu Pingali of Gates Foundation remarks at the Borlaug Dialogue/World Food Prize ceremony in Iowa* (available at http://ilriclippings.wordpress.com/2010/10/15/prabhu-pingali-of-gates-foundation-remarks-at-the-borlaug-dialogueworld-food-prize-ceremony-in-iowa/).

Pinstrup-Anderson, P., ed. 2010. *The African food system and its interactions with human health and nutrition*. Cornell University Press.

PES AND ECO-CERTIFICATION IN THE KAPINGAZI WATERSHED, KENYA

Ilaria Firmian[1], *Delia Catacutan*[2], *John Gatenya*[2] *and Sara Namirembe*[2]
[1]International Fund for Agricultural Development (IFAD), Rome, Italy
[2]World Agroforestry Centre (ICRAF), Nairobi, Kenya



The catchment of the Kapingazi River forms part of a much larger Mount Kenya East or Upper Tana River catchment and covers an area of 61.2 km^2. The Kapingazi River feeds into the Rupingazi River, which then feeds into the Tana system, contributing water to the Seven Forks Hydropower Reservoirs. These hydropower stations provide 70 percent of Kenya's electricity.

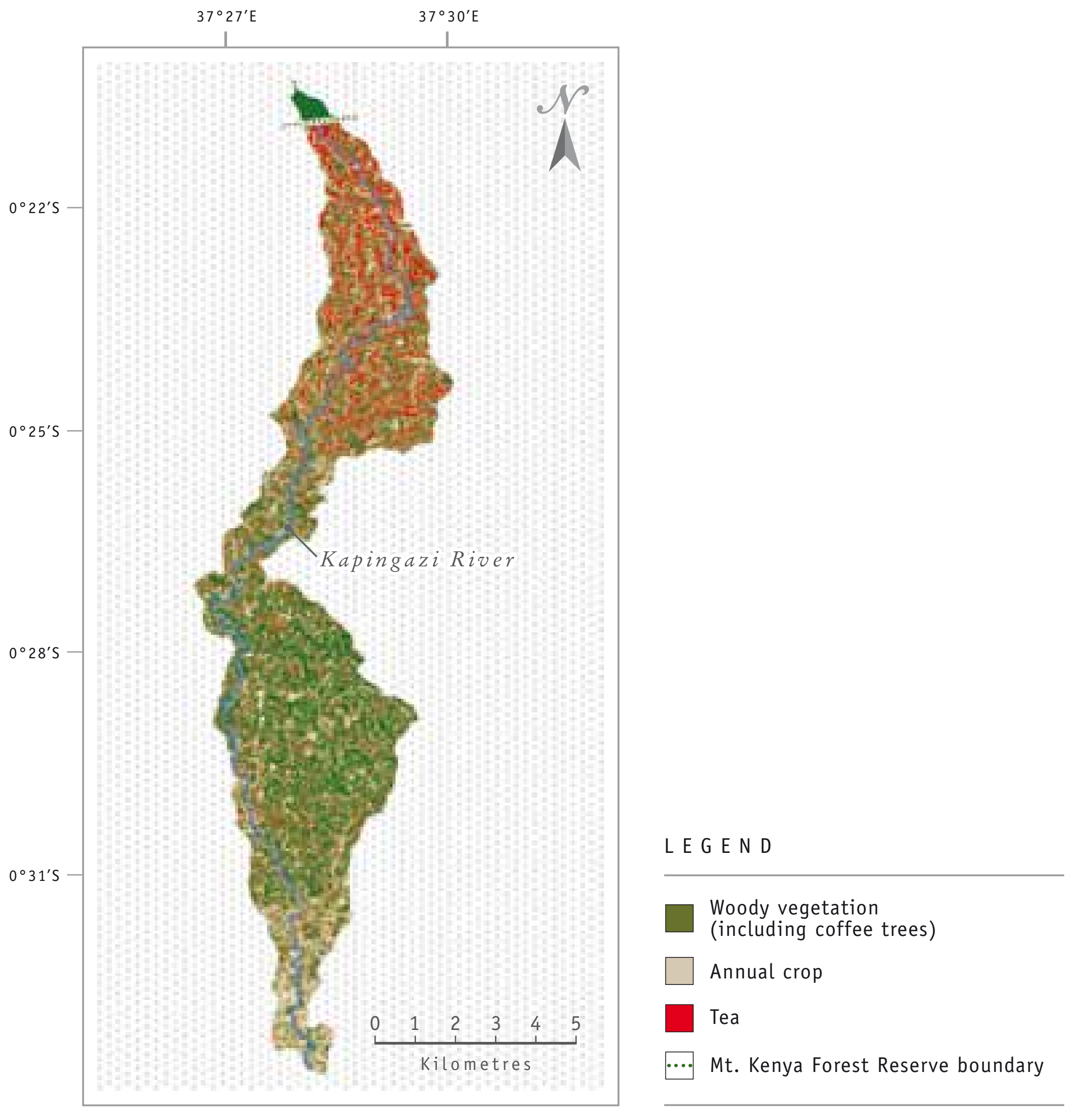
The cropping pattern in the watershed is more or less stratified, with the three main sections managed through different land uses: (a) a tea zone in the upper part of the catchment, especially around Kiriari; (b) a transition zone where both coffee and tea are dominant, around Kairuri; and (c) a coffee zone in the lower part of the catchment (Figure 3). Subsistence farming is practiced mostly with beans and maize. In addition, 'zero grazing' is practiced.

Tree cover is very low in the farming zones. Until 2003, the *shamba* system was in place. This regulatory system allowed farmers to use previously clear-cut forest areas for food production while taking care of newly-planted tree seedlings until the competition between trees and food crops would not permit further cultivation. In the long run, the *shamba* system appeared to fail in curbing deforestation because more land was being cleared for agriculture, resulting in a government ban. Since then, farmers living next to the forests are only allowed limited and controlled access to the gazetted forest to obtain fodder and firewood; the forest provides an important buffer for fodder and firewood supply during the dry season. There was an attempt to bring back the *shamba* system on a trial basis in 2008, but this was generally not accepted and it remains banned.

Increased deforestation associated with population growth (there are approximately 9 000 households in the Kapingazi catchment, with a population of 41 000 inhabitants) is also currently disrupting the ecosystem services associated with the watershed.

In the early part of the rainy season, the river carries a high sediment load due to soil erosion from several exposed areas before the annual crop cover is established. Other bare

Figure 3
Predominant land-use classes in the Kapingazi Watershed in 2005



Adapted from original map by Miika Mäkelä (ICRAF)


© G. Mwaloma/ICRAF

spots include roads, footpaths, homesteads, market centres and other public areas. The erosion risk is highest on the steep slopes of the coffee zone due to the neglect of soil and water conservation structures as a result of low coffee profitability during the 1980s and 1990s. The riverine corridor is used for production of food and fodder, especially during the prolonged dry season. This creates further riverbank erosion.

Dry season water flows are also becoming unreliable. As an example, in 2002, there was a total disruption of the water supply to Embu Town, causing an outbreak of typhoid, which claimed several lives and resulted in a public outcry.

Around Mt. Kenya, a number of initiatives are currently flourishing aimed at restoring ecosystem services and ensuring water supply at the watershed level. Two eco-certification initiatives supported by UTZ-certified (coffee) and the Rainforest Alliance (tea) reward farmers for environmental protection through soil and water conservation, prevention of water pollution, riverbank protection and tree planting. Approximately ten percent of the coffee farmers and all the tea farmers in the catchment are receiving premiums from the sale of eco-labelled coffee and tea.

MUNGANIA TEA FACTORY LTD.

The Mungania Tea Factory in the Kapingazi catchment is one of four factories in Kenya that were included in a pilot certification project by the Rainforest Alliance (the others are Momul Tea Factory Company in Kericho West District, Ngere in Thika, Nyansiongo in Kisii, and Mungania in Embu). They now sell tea at a premium in the international market and the increased income is passed on to the small-scale farmers who are its shareholders. The Rainforest Alliance requires that farmers protect the natural forests within their jurisdiction and plant indigenous trees to boost forest cover. It also obligates farmers and factories to produce tea ethically by avoiding child labour and protecting the health of workers both at the farm and factory levels.


© M. Mäkelä and S. Wachira/ICRAF

Table 2
Income and payout of Mungania Tea Factory Ltd

Total factory income in million Ksh.	Total payout to farmers in million Ksh.	% of total payout to farmers to total income	Total rate* of green leaf per kg in Ksh.
1 032.0	794.8	77	48.88

Note: Ksh. = Kenyan Shilling
*initial payment plus bonus

There are 8 500 farmers bringing tea to this factory, of which approximately 60 percent of the farms are in the Kapingazi catchment. This would indicate that some 3 400 farmers bring tea to the Mungania Tea Factory. Over 80 percent of tea produced in Mungania is bought at a premium by Lipton. The factory was certified in 2009 and farmers in Mungania have started to obtain their payments.

RIANJAGI COFFEE FACTORY

The Rianjagi Coffee Factory is one of ten coffee factories in the catchment. It supports 1 500 farmers, of which about 800 are in the Kapingazi catchment. The factory was certified by UTZ Netherlands in 1997 and they have managed to successfully undergo their annual surveillance audits. However, the product premiums are dismal. Every year they pay Ksh. 170 000 for the audit by Africert Ltd. According to the farm manager, the premiums were their best in 2008 at Ksh. 200 000; generally though, they can go as low as Ksh. 20 000, meaning the cooperative has to maintain the certification status with their own funds. The factory produces one million kilograms of coffee cherries annually. The average annual production per tree is two kilograms; this is well below what well-managed coffee should produce (i.e. up to 18 kg/tree/year). As such, the farmers in Rianjagi are not any better off when compared to others who do not have

Previous pages (from left to right):

↖ An example of soil and water conservation practices in the Kapingazi catchment area, where crop cultivation has left a strip of natural vegetation along the river bank.

↖ Small cultivated plots on a slope showing signs of soil erosion in the Kapingazi catchment area.

Current pages (from left to right):

→ View of small-scale tea plantations east of Mount Kenya.

→ Coffee berries are washed at one of the coffee factories in the Kapingazi catchment area.

certification. The quality of their coffee is average and the prices fetched are lower (e.g. Ksh. 45 per kilogram, compared to peaks of Ksh. 60 per kilogram in the 2009/2010 coffee year). The main problems encountered so far include:

- The factory management claims that they have no knowledge or access to markets for UTZ-certified coffee. They only sell a small fraction to certified-coffee buyers; the rest is sold on the open market, like any other coffee.
- Production is very low because the farmers are not able to apply the recommended inputs due to the high cost and low returns.

These certification programmes constituted an important background for PES implementation because certification has already empowered small-scale farmers in the Kapingazi catchment area. Farmers have received training on better crop husbandry, as well as on best practices to employ in their farms and to stop riverbank encroachment.

PRO-POOR REWARDS FOR ENVIRONMENTAL SERVICES PROJECT (PRESA)

The IFAD-funded and ICRAF-implemented Pro-Poor Rewards for Environmental Services project (PRESA) is supporting farmers in the Kapingazi catchment to implement land-use technologies, such as terracing, grass strips, *fanya juu* and *fanya chini* (i.e. cut-off drains and diversion ditches to collect runoff from the hillside) and other soil conservation techniques. During the next project stage, these technologies will be further reviewed, based on certain criteria, such as: quality and quantity of biophysical services; social, financial and economic feasibility; effort per unit of service generated; opportunity costs; required duration to deliver services; potential for up-scaling; land tenure/availability; size; etc. In addition, predictive models will be used to assess the potential impacts of these and any new technologies on the ecosystem service compared to the baseline scenario.

© D. Catacután/ICRAF

PRESA further aims at implementing water PES schemes that could be associated with the existing eco-certification initiatives. The added value of water PES to eco-certification is that:

- Water payments provide a safety net for maintaining soil and water conservation even when prices slump or production drops due to other causes. For example, though apparently there is scope to reward farmers by linking them to markets for certified tea and coffee, it does not seem to be working well in the case of coffee.
- Eco-certification may not cover all the landowners in the watershed — most of the farms in Muthatari focal development area (the lowest part of the watershed, accounting for approximately 20 percent of total area) do not grow either tea or coffee. Thus, PRESA is investigating the potential for the land-use practices and technologies mentioned above to generate water service rewards for a broader section of farmers in the Kapingazi River catchment. PRESA is also engaging with the Kenya Electricity Generating Company Limited (KENGEN), a potential PES buyer, as the leading electric power generation company in Kenya, producing about 80 percent of electricity consumed in the country.

PRESA research is expected to generate lessons for up-scaling within the whole Upper Tana catchment.

So far, PRESA has conducted an assessment of erosion hotspots in the catchment and found that in the tea zone where rainfall is high and soils are relatively more erodible, any bare area is vulnerable to soil erosion. Other areas prone to erosion include steep slopes in the coffee zone. A hydrological assessment will be carried out to determine the impacts of land-use conversion from tea or coffee to annual crops, woodlots or agroforestry. This will be used together with the ongoing study on drivers of land-use change to understand what could happen in the future if these or similar conversions take place. Further insights about the relationship between land use, water balance and water quality will be obtained once the hydrological assessment

Current pages (from left to right):

→ A section of the Kapingazi River with heavy sediment load.

→ Most residents in the Kapingazi catchment area lack piped water and have to carry water from local rivers and streams for home use, watering vegetables and raising livestock.

is complete. The assessment of soil erosion risk was completed in 2009 and is being revised with higher resolution data. The results of this work will be used in negotiating with potential buyers of ecosystem services and to assess their willingness to pay (WTP).

Technical studies on the willingness to accept (WTA) were completed in 2010. People with larger landholdings demanded greater payments in order to enter into land management contracts. Furthermore, people who were already part of the Mount Kenya East Pilot Project (MKEPP), funded by IFAD/GEF, were willing to enter into contracts for relatively lower payments, possibly because they were already benefiting.

The integration of PES and already existing eco-certification presents both challenges and opportunities. Opportunity associated with working with coffee and tea farmers is that the farmers are already organised. Various organizations, such as Technoserve, are also helping farmers to improve governance of the cooperative societies. Technoserve is also already working in the Kapingazi catchment on this initiative.

A major challenge would be the question of additionality for already eco-certified farmers, particularly whether they should also receive water payments for soil and water conservation practices already in place. Furthermore, from ongoing PRESA research in the East Usambaras, it was found that if the incentive is not large enough, the motivation to conserve is diminished; boosting the modest payments for eco-certification through PES would, thus, improve that motivation.

REFERENCES

Bedru, B. 2010. *Assessing landholder preferences for alternative land management schemes and willingness to accept rewards for watershed services provision: The case of Kapingazi River basin, Mt. Kenya East*. Final report. Nairobi, World Agroforestry Centre (ICRAF).

CHAPTER 2

RELEVANCE OF OECD AGRI-ENVIRONMENTAL MEASURES FOR PES

Nick Lampkin
Organic Research Centre, Newbury, United Kingdom

CONTENTS

ABSTRACT

This chapter reviews the development of agri-environmental policies in the European Union (EU) and other Organisation for Economic Co-operation and Development (OECD) countries, both in historical terms and in terms of the characteristics and challenges of different approaches. The process of reforming the EU's Common Agricultural Policy (CAP) and, in particular, the likely increased emphasis on payments for public goods (positive externalities and ecosystem services) is also reviewed. Key issues from the OECD experience are highlighted, including: the problem of indentifying the level of provision of public goods and the resulting focus on payments for prescriptions not outputs; the issue of cost-effectiveness of schemes and the balance between targeted schemes and schemes based on land-use systems; and the need for other policy measures, including research and training, to provide a base and supportive framework on which PES schemes can be built. The experience with private-sector or market-led solutions is also reviewed. Finally, some key points for the development of schemes elsewhere are identified.

AN OVERVIEW OF EUROPEAN AND OECD AGRI-ENVIRONMENTAL POLICIES

European Union

The earliest substantive development of agri-environmental measures took place in Europe in the 1980s with a number of national initiatives in individual member-states and in European Free Trade Association (EFTA) countries, some (e.g. Austria) later to become full members of the European Union (EU). Agri-environmental measures have been a central feature of EU-wide agricultural policy since the mid-1990s, when Regulation 2082/92 was implemented for the period 1994-1999 as part of the McSharry reforms. In broad terms, the Regulation 2082/92 policy framework provided for:

- **Input reduction schemes, including organic farming**;
- **Extensification of production**, including conversion of arable land to permanent grassland;
- **Decrease in stocking rates for livestock**;
- **Preservation of rare breeds**;
- **Establishment and maintenance of woodlands**;
- **Long-term setting aside of land**;
- **Public access to farmland**;
- **Training and advice to improve ecological performance**.

Payments were mainly based on per hectare or per animal amounts, which were calculated according to costs of compliance with scheme requirements, income forgone and (initially at least) an incentive to participate in the programme. Unlike the mainstream commodity support programmes, which were fully EU-financed and applicable on a common basis across the EU, the agri-environmental programmes could be implemented in different forms in each member state (and in regions within states) and were co-financed by the EU and member states according to fixed rules. As a result, a very wide range of schemes and payment rates can be found across the EU.

While the ideas of Payments for Ecosystem Services (PES) have underpinned the EU agri-environmental schemes from the outset, the implementation of these ideas has been more complicated in practice, due in part to the difficulties inherent in measuring the environmental outcomes — an issue that will be revisited below. In practice, the guiding premise has been that schemes should deliver significant environmental benefits over good agricultural practices. This was reinforced following the 2003 CAP reform agreement, together with the introduction of cross-compliance and Good Agricultural and Environmental Practice (GAEP) requirements for Single Farm Payment eligibility from 2005. Agri-environmental measures were formally integrated with other rural development measures as part of the Agenda 2000 reforms from 2000-2006. This has continued in the 2007-2013 framework, with agri-environmental (or land management) measures forming the second pillar of the Rural Development Programme. In broad terms, the types of instruments envisaged have not changed significantly, although agroforestry was introduced as an option and has been adopted in a few countries; options to introduce schemes focusing on animal health and welfare were also introduced. Cooper *et al.* (2009) provide a detailed overview of the different schemes currently in place.

Since the mid-1990s, agri-environmental measures have been a key issue in the agricultural policy of the European Union

With the increased emphasis on climate change and soil and water protection, in addition to biodiversity conservation, in the CAP Healthcheck of 2008, the emphasis within agri-environmental measures has begun to shift and may lead to more significant changes as part of the current CAP reform debate.

Switzerland and other EFTA countries

Switzerland, as with other European Free Trade Association (EFTA) countries, has traditionally provided higher levels of support to its agricultural sector than most other OECD countries. As with other OECD countries, the focus until the 1990s was on commodity support measures. In 1998, strict environmental cross-compliance requirements (proof of ecological performance) were introduced, including animal-friendly husbandry, balanced nutrient budgets, a minimum of seven percent of land area set aside as ecological compensation areas, rotations, soil protection and a reduction of pesticide inputs. Within this framework, already pre-1998, extensive production systems and organic farming received specific support. In 2001, the Ordinance on Regional Promotion of Quality and Networking of Ecological Compensation Areas in Agriculture introduced an additional, result-oriented remuneration scheme for agricultural and nature conservation practices. This focuses on a number of different habitat types and management options for farmers.

These approaches have been reinforced in subsequent policy reforms at 4-5 year intervals, but there is now an intense debate about the future when the current framework ends in 2011, in particular with respect to the environmental outputs achieved and the cost-effectiveness of different approaches to delivering them (Schader, 2010).

Norway also provides support for organic farming and for maintaining mountain summer grazing pastures, with soil conservation measures introduced in 1994 and a general landscape measure introduced in 2004, linked to environmental cross-compliance. In Iceland, support is restricted to soil conservation and forestry schemes (OECD, 2009).

United States of America

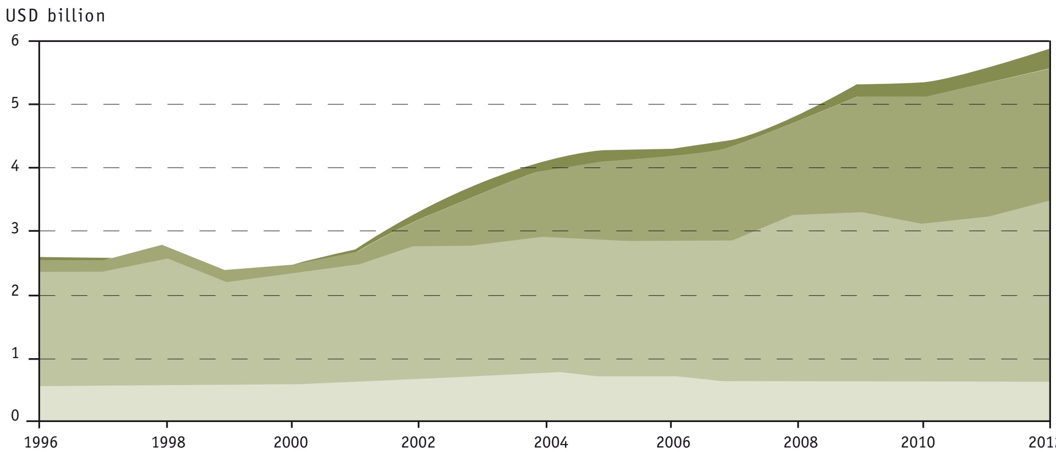
The history of the development of agri-environmental payments in the United States of America (USA) has been somewhat different (Figure 4), with the majority of payments prior to 2002 being devoted to land retirement schemes that paid farmers to take environmentally-sensitive land out of crop production for specific periods (USDA, 2009). The 2002 Farm Security and Rural Investment Act substantially increased funding for agri-environmental measures on cropped and grazing lands. Further significant reform took place as part of the Food, Conservation and Energy Act of 2008, which expanded support for:

- **Working-land programmes** providing technical and financial assistance to farmers who install or maintain conservation practices on land in production, including assistance for conversion to organic production and specific support for limited resource, beginning and socially-disadvantaged producers;
- **Land retirement programmes**, including conservation and wetland reserves, which generally remove land from agricultural production for a long period (at least ten years) or, in some cases, permanently;
- **Agricultural land preservation programmes** enabling purchasing of the rights to certain land uses, such as development, in order to maintain land in agricultural use;
- **Conservation Technical Assistance (CTA)** providing ongoing technical assistance to agricultural producers who seek to improve the ecological performance of their farms.

Like the EU, the USA has baseline environmental compliance requirements for its mainstream commodity support programmes, emphasizing the use of additional financial support, supplemented

Figure 4

Trends in major USDA conservation programme expenditures 1996-2012



LEGEND

- Agricultural land preservation (FPP and GRP)
- Working land (EQUIP, CSI/CStP, and WHIP)
- Land retirement (CRP and WRP)
- Technical assistance (CTA)*

*CTA is funded through annual appropriations, assumed here to continue at 2007 level of USD 627 million through 2012.

Adapted from USDA, 2009

by research and education, to address environmental problems where the effects are diffuse. In such circumstances, it is difficult to attribute responsibility to an individual producer and to address the problem via regulation. However, conservation compliance programmes, aimed at reducing soil erosion and the protection of wetlands, have been successful and are being maintained (USDA, 2009).

OECD COUNTRIES

OECD (2009) provides a more wide-ranging review of agri-environmental policies applied in different OECD countries. The OECD review identifies a range of mechanisms by which environmental issues in agriculture are addressed in OECD countries, including:

- Regulatory requirements;
- Agri-environmental payment schemes;
- Environmental taxes;
- Tradable rights and quotas;

- Environmental cross-compliance;
- Community-based approaches;
- Research and extension.

While most OECD countries have a strong framework of environmental regulation in place and some OECD countries, notably Australia and New Zealand, rely primarily on these regulatory mechanisms, such policies tend to be taken as a given and rarely play a central role in agri-environmental policy debate. Over the last decade, however, environmental cross-compliance, as implemented in the EU, USA and Switzerland, has increasingly become a regulatory feature of eligibility for mainstream support measures, with the combination of regulation and cross-compliance providing a baseline for environmental protection in agriculture.

Research and extension activities designed to investigate and improve environmental performance are also widespread and provide an essential pre-requisite for an evidence-based approach to policy-making and evaluation. A few countries have engaged with environmental taxes (e.g. on pesticide and/or fertiliser inputs in Denmark, France, Italy, Norway, Sweden and some states in the USA), on tradable rights and quotas (e.g. wetlands development in the USA and water extraction rights in Australia) and on community-based approaches (e.g. Landcare[1] in Australia). However, these cannot yet be described as mainstream approaches to environmental management in agriculture. Agri-environmental measures in most OECD countries, therefore, represent the primary means by which environmental outputs beyond those which can be secured by regulatory, cross-compliance and educational approaches are delivered. The OECD (2009) categorises these as:

Most OECD agri-environmental schemes include incentives for agriculture that preserves ecosystem services and natural capital

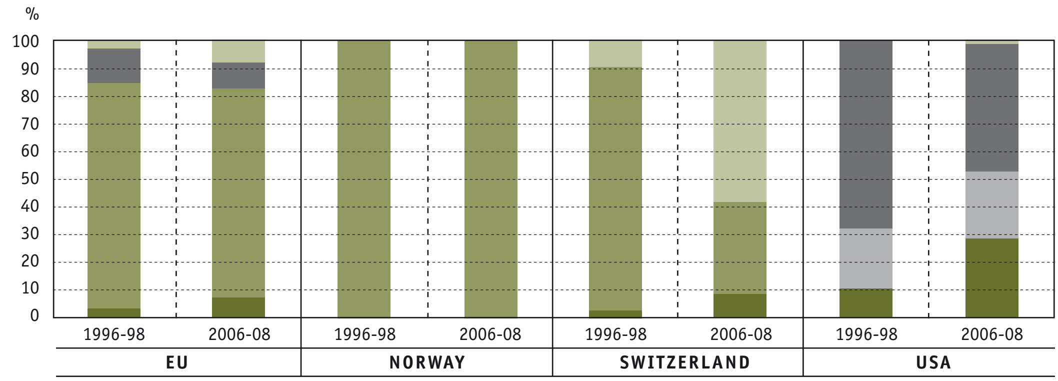
- **Payments based on farming practices** that go beyond regulatory requirements and/or compliance with good farming practice, including: payments based on inputs, payments based on area/animal numbers, and payments based on specific non-commodity outputs;
- **Payments based on land retirement**;
- **Payments based on farm fixed assets** (i.e. investment-related);
- **Payments based on technical assistance** (on-farm training and advisory activities).

According to the OECD (2009), there has been a small shift to payment for non-commodity outputs over the last decade, which has been particularly marked in Switzerland, while land retirement schemes have declined in importance in both the EU and the USA (Figure 5).

1 http://www.landcareonline.com.au

Figure 5

Structure of agri-environmental payments in selected OECD countries in 1996-1998 and 2006-2008



EU 15 for 1996-1998 and EU 27 for 2006-08

L E G E N D

- Payments based on input use
- Payments based on area/animal numbers
- Payments based on a specific non-commodity output
- Technical assistance on farms
- Long term resource (land) retirement

Adapted from OECD, 2009

It is notable that in Japan and Korea, both of which have relatively high levels of agricultural policy support, agri-environmental schemes were introduced only relatively recently, while in other countries, such as Mexico and Turkey, limited agricultural policy budgets have been prioritised for other purposes. However, Mexico also has a programme to encourage sustainable agriculture, while Turkey has been introducing a series of initiatives to support organic farming over the last five years. Korea has had a scheme to support reduced input use, including organic farming, initially (since 1999) in water catchment areas, but since 2002 extended across the whole country, with measures for environmentally-friendly livestock production introduced in 2004. Support for reduced input use was only introduced in Japan in 2007 (OECD, 2009).

SCOPE OF THE EU COMMON AGRICULTURAL POLICY (CAP) AND OTHER OECD EXPERIENCES ON AGRI-ENVIRONMENTAL MEASURES

It is clear from the preceding review that, within the frameworks provided by the relevant regulations in the EU and other OECD countries, a wide range of approaches have been adopted, reflecting both local environmental priorities and resource availabilities, as well as differing policy perspectives on the roles that markets and policy interventions should play.

While it is difficult to summarise the full range of approaches used concisely, some key schemes include:

- **Input-limiting schemes**, which reduce or prohibit the use of fertilisers and pesticides, for example: schemes with specific input limitations, and **integrated farming schemes** and/or organic farming schemes where inputs are restricted along with other requirements;
- **Agricultural extensification schemes**, particularly those that restrict livestock numbers on grasslands;
- **Habitat restoration and habitat conservation schemes**, with specific management prescriptions to recreate or maintain habitats or species (including rare breeds);
- **Land-use change or land retirement schemes**, including conversion of crop land, grassland, or (agro)forestry and farm woodland establishment schemes, with increased emphasis on climate change issues and some schemes to reverse previous land drainage for agriculture in order to prevent further degradation of peatlands;
- **Financially-supported investment schemes** in infrastructure for environmental gains, including restoring stone walls and buildings representing cultural landscapes, fencing to protect hedges from browsing or housing for livestock in the winter to reduce damage to pasture;
- **Catchment area schemes**, which aim to encourage all farmers in an area to participate, for example, to maintain water quality.

Despite the variety of schemes, in general terms, there is a broad acceptance of the principle that policy intervention in all these cases may be justified because there is evidence of market failure. This is most clearly the case where positive externalities and ecosystem services are provided by farmers. These services are typically not purchased in a market framework because the benefits accrue to society as a whole, rather than to individual consumers. Even in cases where a market may exist, e.g. consumption of landscapes via agrotourism, the sellers of tourism services (e.g. accommodation, restaurants, travel companies) may not be those that are responsible for the delivery of the landscape qualities attracting the tourists.

Even in the case of negative externalities and the general agreement among OECD countries to apply the 'producer pays' principle, the prevalence of non-point externalities (e.g. diffuse pollution of watercourses and greenhouse gas emissions) in agriculture means that it is often not possible to define the polluter and may require some form of financial reward to address specific problems. While it may be possible to consider alternative options, such as taxes on inputs (energy, water, fertilisers, pesticides), the level of taxes required to achieve change in practice may be too high. Moreover, the consequent transfer of income out of agriculture potentially conflicts with other policy measures aimed at supporting agricultural incomes, including input subsidies in some cases.

There is an argument that production according to defined and high environmental standards might achieve some recognition by consumers in the form of willingness-to-pay (WTP) price premiums, for example, organic farming and other sustainable agriculture certification schemes or Products of Distinct Geographical Origin (e.g. PDO/PGO designations). However, it is questionable whether the small minority of consumers willing to pay a premium for these products are doing it in order to pay for public benefits or even whether they should, given that many other citizens will then be getting the benefits for free (the 'free-rider' problem).

There is also a potential problem where the agri-environmental incentives conflict directly with the marketplace. This tension exists, for example, with respect to schemes designed to encourage conversion to organic production, which may result in increases in the supply of organic products above current demand, resulting in falling prices, with all producers, including those who may have converted without support, being worse off. The resolution of this is challenging — if the environmental benefits are derived from land management, as opposed to the marketing of products, does it make sense in environmental policy terms to restrict the adoption of land management practices to a level that the market can withstand, thus also limiting the delivery of ecosystem services, or would it be better to de-emphasize the link to the marketplace and to find other means to address that particular problem? In Sweden, for example, producers participating in organic farming agri-environmental schemes were not required to be certified as organic (their status being monitored by policy officers instead). However, if not certified they could not (under EU law) market their products as organic. Farmers then have the option to become certified separately if they wish to engage with the formal organic market, allowing a more gradual development of supply.

The 2003 EU-CAP reform saw the introduction of Single Farm Payments and environmental cross-compliance regulation

If the case for agri-environmental interventions due to market failure is accepted, then there is still room for debate about the basis for calculations for payments and the most efficient approach to be used (see also Chapter 3 "Opportunities and gaps in PES implementation and key areas for further investigation").

One such argument arises with respect to the balance between 'broad' and 'shallow' payment schemes. Broad schemes have relatively low requirements and payment rates, but may be adopted by a much larger number of farmers; shallow schemes are more focused, intensive schemes having higher payment rates, but lower levels of uptake. Put simply, is it better to have a scheme delivering ten units of output per farm taken up by 50 percent of farmers, or a scheme delivering 50 units of output per farm taken up by only ten percent of farmers and how cost-effective are these different options? In practice, a combination of the two options may well be the most effective solution.

A related debate centres on the criteria used to determine the level of payment. Typically, many payment schemes are based on per hectare payments, which are not differentiated significantly between farms within a region, in part because the transaction costs associated with more tailored payment rates may be too high. However, if a uniform payment rate is calculated to cover the costs and income forgone of the average farmer, there will be some who have lower than average costs and will be over-compensated, but may be more likely to participate, while there are others who will have higher costs and be under-compensated and less likely to participate. Reducing payment rates to reduce over-compensation of some producers may result in more being under-compensated and reduced uptake (see also Chapter 3 "Opportunities and gaps in PES implementation and key areas for further investigation"). To try to avoid this, various approaches involving tendering have been proposed, which might link producers' costs or willingness to engage more directly with the payment on offer; however, in practice such alternative approaches have not been widely adopted (see Chapter 4 "Cost-effective targeting of PES").

CHANGES FORESEEN IN THE UPCOMING EU-CAP REFORM

Within the EU, there is currently intense debate about the future of the Common Agricultural Policy (CAP) with specific reference to the 2014-2020 policy programming period. CAP reform has been an ongoing process since the early 1990s, with the introduction in 1994 of arable area payments, set-aside and livestock headage payments to replace previous price support mechanisms and address the surplus production problem. The changes were accompanied by a variety of measures, including the agri-environmental measures referred to previously in this chapter, but also a range of marketing, training and other support programmes.

The Agenda 2000 reforms for the 2000-2006 period did not fundamentally alter the process initiated in 1994, but it did see the crystallisation of the two 'pillars' of the CAP, the first pillar being the traditional CAP commodity measures and the second pillar being a new Rural Development Programme formed by bringing together agri-environmental, forestry, market development, capital investment aids, rural diversification, vocational training and other measures. These were measures that all had separate existences previously and to a large extent continue to operate independently as a result of pre-existing EU and national government institutional structures.

Major changes to the first pillar were finally agreed with the 2003 mid-term review of Agenda 2000 and implemented from 2005, involving the introduction of the Single Farm Payment to replace many of the separate commodity support measures. Since then, other commodity support programmes have been progressively integrated into the Single Farm Payment so that there are now few remaining commodity-specific supports in place. At the same time, a new environmental cross-compliance regime was introduced to ensure basic minimum agri-environmental and animal welfare standards. This regime also gave the EU and member states the power to refuse to make support payments in cases where regulations or the codes of Good Agricultural and Environmental Practice (GEAP) were being breached.

As a result of the major changes implemented in 2005, the 2007-2013 programme saw relatively small changes to support to the first pillar. However, the Rural Development Programme (the second pillar) was restructured around four axes. The first three axes (economic, environmental and social) were notionally linked to the familiar concept of sustainability, with:

- **Axis 1 focusing on economic issues**, in particular market development, capital investments and human capital development;
- **Axis 2 focusing on environmental and land management issues**, including agri-environment schemes, as well as forestry, agroforestry, rare breeds and animal welfare; and
- **Axis 3 focusing on social or rural community issues**, primarily via measures designed to support the diversification of rural enterprises.

Axis 4 was used to support bottom-up, community-led approaches to policy-making and integrate the previous LEADER programmes. However, under the 2007-2013 framework, these programmes have tended to become more institutionalised and arguably less innovative, although a focus on the development of pre-commercial ideas has been retained.

A key issue for the restructured Rural Development Programme was to avoid the four axes becoming 'silos' with little or no interaction between them. The European Commission placed some emphasis on exploiting cross-axes synergies — for example, with respect to organic and integrated farming where agri-environmental support could be reinforced by marketing, training and rural diversification support. While it is difficult to see extensive use of cross-axis approaches in the rural development plans of many member states, many of the action plans for organic farming and similar initiatives applied at national and regional levels relied on drawing support from the different axes.

The 2008/2009 CAP Health Check saw further decoupling of the first pillar's (mainstream commodity measures) payments and encouraged members states to move to flatter rates of support — i.e. to reduce the extent to which payments to individual farms were based on what they had historically received under the old regimes. It also introduced a new Article 68 providing for targeted measures to address the economic and environmental disadvantages in certain regions/sectors. In a few countries, Article 68 has been used to 'supplement' agri-environmental support under the second pillar, although there are rules to prevent duplication between the two funding streams. The Health Check also picked up on key 'new' challenges, including climate change, biofuels, water management, biodiversity and soil conservation, which were reflected in modifications to the second pillar (agri-environmental and rural development measures), together with an increased level of modulation to support the transfer of funds from the first to the second pillar.

While some have argued that the current CAP Reform debate provides an opportunity to end subsidies to farmers, it is unlikely that the reforms will be this radical — the experience of the 2000 and 2007 reforms is that radical-sounding reforms are negotiated away in the compromises needed to ensure agreement between the 27 member states and, at best, some modest reforms, with a probable reduction of the overall CAP budget and a further shift of resources from the first to the second pillar, may be achieved. The 2014-2020 CAP reform debate is taking place within the context of the recently agreed Europe 2020 strategy for 'smart, sustainable and inclusive growth' (EC, 2010a). Prepared in the wake of the global economic crisis, the 'Brussels' strategy agreed by the European Council in June 2010, like its predecessor Lisbon and Gothenburg strategies, struggles to balance economic growth with environmental sustainability, aiming for:

The 2014–2020 CAP reform is focused on the agreed Europe 2020 strategy for 'smart, sustainable and inclusive growth'

- **Smart growth:** Developing an economy based on knowledge and innovation;
- **Sustainable growth:** Promoting a more resource efficient, greener and more competitive economy;
- **Inclusive growth:** Fostering a high-employment economy delivering social and territorial cohesion.

In some senses, this continues a trend that started in Lisbon, of reducing the emphasis on environmental issues compared with Gothenburg, but clearly also reflects the financial crises and public expenditure constraints of recent years.

Initiating the debate on the latest round of CAP reform, the European Commission identified food security, sustainable land management, viable rural areas, competitiveness in global markets and responding to climate change as key deliverables from agriculture and that policy intervention was needed to address volatile markets, the delivery of public goods and a sustainable rural environment (EC, 2009). To a certain extent, this reflects a continued commitment to the original CAP objectives from the Treaty of Rome, which were retained unaltered in the Lisbon Treaty. However, it also recognises the new challenges imposed by climate change and the need to better address the provision of public goods by agriculture. In addressing this, the European Commission is particularly concerned about maintaining a level playing field and slowing the trend to re-nationalisation of agricultural policies, arguing for:

- **A common regulatory framework to secure minimum standards**;
- **A basic direct payment to secure food production** and provide a safety net in the face of volatile markets and delivery of public goods, but which is decoupled from producers' production decisions and market orientation;
- **Targeted measures to address specific regional circumstances**, economic diversification and environmental challenges including climate change and water management.

Two key issues that the European Commission is trying to address are: (a) what tools can be used to reduce market volatility following the rapid price increases in 2007, the subsequent falls in 2008/2009 and large increases (for cereals) again in 2010, without reverting to previous price support measures; and (b) how the direct payments (the first pillar Single Farm Payment scheme) can be more directly linked to the provision of public goods, with discussions focusing on mandatory environmental set-aside and other land management measures.

Although the increased emphasis on climate change and water management issues was stated in 2010, it is still not clear what specific reforms to agri-environmental policy will be proposed. The European Commission is engaged in a public consultation process, which was launched in May 2010 and culminated in a conference in July 2010[2], with formal proposals from the Commission presented at the end of 2010 (EC, 2010b).

The web-based public consultation received a large number of responses, but was less conclusive about the types of policies that should be implemented, with a distinct division between those seeking a greater emphasis on food production and profitability versus those looking for environmental gains.

A key unknown at this stage is the availability of financial resources for the EU Rural Development Programme in general and for agri-environmental measures in particular. With all EU governments seeking to cut back on expenditure, it is likely that resources will be more limited than in previous policy planning periods, even if there is a shift of resources from the first to the second pillar. For this reason, a much bigger emphasis is being placed on discussions of cost-effectiveness than in previous discussions, a trend which is also being seen in other OECD countries, such as Switzerland. A second point of greater emphasis in the debate is the focus on public benefits in both pillars. Clearly and not just because of the immediate financial pressures following the recent recession, there has been a swing against particular industrial sectors being supported for their own sakes. Agriculture has not been immune to this, even though it may have a compelling case to make concerning its uniqueness with respect to food security and the climate/biological uncertainty with which it has to work. There is a clear expectation from environmental interest groups and increasingly from political parties, whatever their position on the political spectrum, that support for agriculture needs to be justified in terms of benefits to society.

In terms of the European Commission's current consultation on the way forward, the issue of public benefits is, therefore, much more visible, even though the argument has been around for the last 20 years, if not longer. Cooper *et al.* (2009) were contracted by the European Commission to set out the issues with respect to public good provision by agriculture. They make the familiar case that the nature of public goods is such that consumers are not willing to pay for them and producers are unwilling to produce them as there is no market for them. Given that many public goods are associated with land, that most land use is agricultural and that

2 http://ec.europa.eu/agriculture/cap-post-2013/index_en.htm

land use is primarily determined by private ownership rights, there is a continued justification for policy intervention to secure the provision of public goods by farmers.

Of the public goods generated by agriculture, Cooper *et al.* (2009) emphasize environmental goods, such as agricultural landscapes, farmland biodiversity, water quality, water availability, soil functionality, climate stability (greenhouse gas emissions), climate stability (carbon storage), air quality, resilience to flooding and fire, as well as a diverse suite of more social public goods, including food security and quality, rural vitality and farm animal welfare and health. While many of these may be considered tangible benefits, a number reflect less tangible concepts of security, stability/maintenance and resilience that are as relevant to food production and the environment as they are to energy security and military defence.

Cooper *et al.* (2009) argue that while the agri-environmental and environmental cross-compliance measures previously implemented have succeeded in stemming decline in several areas of public good provision, there is a need for clearer target setting and improved cost-effectiveness of measures, as well as a need to learn from some of the more innovative, smaller-scale programmes currently being implemented. They also argue that the delivery of public goods can be achieved both by encouraging intensive producers to adopt specific environmental measures and by encouraging specific farming systems that tend to be associated with the provision of public goods, including extensive livestock and mixed agricultural systems, more traditional permanent crop systems and organic systems.

LESSONS FOR PES
Definitions of externalities and ecosystem services

Externalities usually refer to the effects (costs/benefits) of human activities that are not transmitted by the price mechanism/subject to the economic transactions between actors. Externalities may be negative (external costs), as in the case of pollution associated with a production activity, or positive (external benefits), such as the aesthetic value to be derived from a diverse agricultural landscape (see also Chapter 1 "The role of PES in agriculture"). Normally, negative externalities, as they are not mediated by market prices, would be controlled by policy intervention through regulations, including application of the 'polluter pays' principle and potentially through restrictions (quotas) or taxes on specific practices or inputs to reduce potential damage to public goods. In some cases, a tradable permit to produce negative externalities may be introduced to enable the price mechanism to be applied to regulating production of the negative externality (see also Chapter 8 "PES within the context of Green Economy").

Negative externalities are often controlled by policy interventions aimed at restricting specific potentially damaging practices

By contrast, a positive externality exists where there is a benefit to other individuals, but there is no means of capturing the value those individuals place on the benefit by means of a price paid to the generator of the externality. In such cases, the free-rider problem can exist (i.e. the unwillingness of some to pay for a benefit that can anyway be obtained for free). However, there may be ways in which a price can be extracted collectively by appropriately authorised organizations, for example, by charging entry fees to a national park, or by a water company charging customers for clean water and paying all the farmers in the catchment area for their efforts to protect the water sources.

Unlike externalities, which are always a consequence of human activity, ecosystem services may be derived from natural systems outside the direct influence of human management. Examples include the biological processes involved in reproduction, pollination, carbon, water and nutrient cycling and soil formation by different organisms, as well as the harvestable resources that can be derived from biodiversity. Human activity may be directed to support these services, for example, through the design and management of agro-ecosystems, but is not an essential pre-condition. In certain cases, the farmer may be able to capture the benefit of the provision of ecosystem services within the farm, for example, by creating habitats to support the biological control of pests, reducing both pest damage and the need for external inputs (see also Chapter 1 "The role of PES in agriculture"). However, unlike the relationship between purchased inputs and yields, the exact cost and value of the ecosystem service is much more difficult to quantify. In other cases, such as production of clean water and air, the benefits accrue to society at large and there is usually no potential for farmers to be rewarded for their activities through market mechanisms.

Positive externalities are benefits to others but there is no way valuing them though payments to the externality generator

In practice, policy measures may attempt to address externalities and ecosystem services interchangeably but, for obvious reasons, will focus on those that can be influenced by human activity. So, while the distinctions made above may be important for valuation purposes, they may be less important with respect to implementation pathways.

Issues relating to the implementation/evaluation of PES policies

Cooper *et al.* (2009) recognise that many outputs may have both public and private dimensions, so that policy solutions need to encourage the public, while not distorting the private market aspects. There is certainly an attractive political logic in emphasizing positive externalities and ecosystem services as a basis for policy intervention in that the state or private sector reward individuals and companies for the delivery of positive benefits to society. In principle, the agri-environmental measures being implemented in the EU, Switzerland and other countries since the 1990s are not inconsistent with this, although their implementation is not directly compatible with the idea, reflecting some of the compromises that have had to be made in practice and which are probably unlikely to change significantly in the future because the solutions are too difficult. Cooper *et al.* (2009) provide a more detailed analysis of some of these problems and additional examples of output-focused schemes that have already been implemented in the EU. For example, a common point of criticism of the EU agri-environment schemes to date has been the regulatory requirement for payment levels to be determined according to implementation costs and income forgone, rather than the value that might be attributed to outcomes delivered. In terms of accountability for public expenditure, there is a strong auditing emphasis on being able to identify what is being paid for. Many of the environmental externalities in question are diffuse in nature or expensive to quantify and do not lend themselves to this type of accountancy framework. The resulting compromise is that payments are related to a set of management prescriptions that are expected to generate the desired environmental outcomes, even though there is no guarantee that they will, or even a clear idea of the size of the environment benefit that might be generated.

Payments are determined according to implementation and alternative opportunity costs, rather than the delivered benefits

The issue of transaction costs associated with output-based approaches is also significant. If outputs are not standard on a per farm or per unit area basis, then each farm is likely to be generating different quantities of specific outputs, theoretically requiring individual measurements to be made in each case. If this involves inspection visits and direct measurement, the transaction costs can be very high and may exceed the payments to the producers and the value of the services being delivered (see also Chapter 4 "Cost-effective targeting of PES"). In some cases, this can lead to the definition of proxy indicators that are less expensive to monitor. In many situations, this can work successfully, but there is a risk that the use of proxy indicators can result in the focus of schemes switching from, for example, the ecosystem that needs to be supported to deliver the ecosystem services to the indicator itself.

Targeted versus multi-objective approaches

A further issue to consider is the relative merits of targeted measures to deliver specific outcomes, or more systems-based approaches delivering on a range of outcomes. According to the Tinbergen rule (Schader, 2010), there should be at least as many instruments as there are policy objectives in order to provide the most economically-efficient solution. This rule has been used to argue that targeted policies supported by specific instruments are more efficient than multi-objective approaches supported by a single instrument.

Multi-objective systems are often used in integrated or organic farming. However, the production standards underpinning such systems are more complex, having been developed to address a number of different environmental and social goals simultaneously. While there is an even greater challenge measuring the outputs from such systems because of the range of farm types to which the production standards can be applied (from intensive horticulture to mountain pastures), there is broad agreement where such approaches are part of the agri-environmental toolbox and that they deliver on a range of objectives, though perhaps not as intensively with respect to any single objective, rather than a targeted measurement would. The cost-effectiveness of the different approaches will depend on the combination of outputs, payment levels for each measure implemented and the transaction costs involved, which may be significantly reduced in cases where, for example, third party certification systems are used. At face value, however, the Tinbergen rule suggests that targeted policies would be more efficient than a multi-objective approach by preventing having to pay for unwanted results. This has led various agricultural economists (including, most recently, the Swiss Federal Council in 2009) to conclude that systems-focused, multi-objective policies, such as organic farming area support payments, are not economically sound, as the policy goals could be achieved more efficiently by more flexible and targeted combinations of various specific agri-environmental measures.

There is an ongoing need for research and education to understand how human actions can be effective in preserving ecosystems

However, the Tinbergen rule is applicable only where it is assumed that there are no conflicting goals and no transaction costs. Looking at the reality of agri-environmental policy instruments, these assumptions are hardly realized. Conflicting goals and/or detrimental side-effects exist for many agri-environmental policy instruments. Even if policies are designed especially to deal with a single environmental problem, they may have substantial effects on other environmental categories. Schader (2010) analysed this issue in more detail with respect to the cost effectiveness of organic farming as a tool to deliver agri-environmental benefits in Switzerland. His analysis indicates that, provided systems-based approaches are part of a mix of options with targeted approaches, they can be a cost-effective means of delivering agri-environmental outcomes and that the Tinbergen rule critique only applies where systems-based approaches are used exclusively.

While Schader focused on organic farming, the issues discussed in this section would also apply to other integrated/sustainable farming systems, as well as to the more traditional farming systems identified by Cooper *et al.* (2009) as contributing to public good provision. The focus on defined production systems may make it easier to link in market-based mechanisms to encourage them, but there is no reason conceptually why a specific standard for bundled ecosystem services might not be developed as a basis for PES policies.

Complementary measures required

The potential of PES schemes is based on the need for other policy measures to be implemented simultaneously (see also Chapter 8 “PES within the context of Green Economy”). There is a need for regulation and for the ‘polluter pays’ principle to be applied to address most cases of negative externalities. Tradable quotas and taxes may also have a stronger role to play in this context, for example, in the addressing climate change, where primary producers may have a significant role to pay with respect to greenhouse gas (GHG) sequestration and could potentially benefit financially from selling GHG emission credits (see Case Study 10 “Plan Vivo: A voluntary carbon sequestration PES scheme in Bushenyi district, Uganda”). However, the biological nature of primary production, involving significant fluxes of GHGs both with fixation and release, means that it is very difficult to accurately quantify the contributions being made by primary producers, unlike in many other industrial processes where input-output relationships are much clearer.

More important still is the ongoing need for research and education. Research is needed both to understand the nature of the environmental problem and how human actions can be used effectively to address it. Research is also needed to provide evidence on the extent of impacts of normal human activity and the scale of any external benefits or ecosystem services that might be delivered by a relevant policy instrument.

Education, encompassing training, advice, participatory research and other extension activities, is arguably even more fundamental than research, since many actors do not set out deliberately to cause environmental damage, but are unaware of the impacts they are having and the potential for improvement. Education, in a broad sense, is essential to ensuring regulatory environmental cross-compliance, as well as increasing the outputs that can be delivered for a given level of policy investment and reducing the costs to the producer for delivering the outputs sought.

Typically, within the OECD countries, research is undertaken independently of the implementation of agri-environment programmes, although there is an increasing emphasis on mid-term and ex-post evaluations of schemes, many of which have been reviewed by Cooper *et al*. (2009). The 2007-2013 CAP reform saw the general introduction of a Farm Advisory Service (though with restricted funding) to help producers ensure environmental cross-compliance. Training programmes covering technical and environmental issues have also been implemented under both the vocational training provisions of the rural development plans (second pillar), as well as in some cases as a specific part of agri-environmental schemes. For some schemes, for example, the former Countryside Stewardship Scheme in England, project officers were available to help producers develop their environmental plans as a basis for scheme agreements. While there is an administrative reasoning to this, it clearly also includes an advisory/training element. Conservation Technical Assistance in the USA also plays a similar role. However, although advice and training are generally available, the resources allocated are often limited, with participation voluntary and, in some cases, producers are expected to make a contribution to the costs, so uptake is low. In such cases, it could be argued that opportunities to maximise public goods provision may have been missed due to inadequate skills development by operators.

Private sector initiatives

The EU/OECD perspective tends to assume that the state is the main actor responsible for providing PES schemes, thereby representing situations of market failure. This is not the case in all countries though — examples of more market-led approaches can readily be found in the USA and elsewhere (USDA, 2009). There are some situations where private sector companies may lead PES initiatives themselves (see also Chapter 7 "Enabling conditions and complementary legislative tools for PES"). One example is that of food retailers and some processors who may be keen to assert environmental and social values as part of a strategy for differentiating themselves from competitors. In some cases, they may provide a direct financial incentive to suppliers to change practices — more frequently, they may impose environmental, animal welfare and social (e.g. fair trade) standards on their suppliers and these are passed down the chain, not necessarily accompanied by a financial premium to compensate the costs. Where additional costs to the retailer are involved, these may be recouped through higher prices to the consumer or possibly through higher market share.

The private-sector can establish a PES scheme or agree to engage with the public sector in mixed public-private partnerships

An alternative example is that of the water companies that have to comply with water quality regulations and face the choice of either installing water purification equipment to clean-up contaminated water or working with land managers to change practices so as to reduce initial contamination of water catchment areas. In the context of strict EU water quality regulations with respect to pesticide residues, it is often cheaper to pay land managers to reduce or avoid contamination, rather than having to pay for cleaning water supplies after the event. Especially in Germany, but also in other countries, water companies have, therefore, implemented schemes to encourage low or zero use of pesticides and fertilisers (including organic manures) likely to contaminate water supplies. In some cases, these have included support for organic producers. An alternative to payments to land managers to meet specific standards is for the land to be purchased by the water company and then leased to land managers, potentially at reduced rents, for those who are willing to abide by specific conditions.

The land purchase option has also been used by voluntary interest groups (e.g. environmental NGOs) to purchase land and ensure its management is consistent with their specific objectives, including birds, wild mammals, flora, etc. In the UK, the National Trust is the largest landowner of this type and rents out land preferentially to farmers who undertake to meet specific environmental requirements. An alternative to outright land ownership is the use of covenants, which are used in the USA and New Zealand (Cooper *et al.*, 2009). These are legally-binding agreements linked to the title deeds of a property that bind the current and future owners in perpetuity to continue protecting a specific site.

There are also options for a mixed public-private approach, such as organic farming, but also water company catchment protection programmes combined with other agri-environmental schemes.

For some policy-makers, working in a situation which is heavily dominated by public sector approaches to deliver public goods, balancing policy-led and market-led solutions can be a significant challenge because they do not have ownership over and, therefore, do not trust the market-led solutions. This can be seen, for example, in the way in which organic farming, which has the potential to use its market position to support the delivery of environmental outcomes, is dealt with in European agri-environmental schemes. In some countries, such as Sweden, organic farming has been encouraged as an agri-environmental policy in its own right, with certification requirements and market links left to the individual operator to develop separately. In other countries, such as Portugal, failure to market products as organic has been seen as a disqualification criterion, even though the environmental benefits from organic farming result from land management, not marketing activities.

Addressing this apparent conflict between market- and policy-led approaches is partly an institutional issue. If the regulations at the international or national levels are drafted in such a way as to focus attention on specific approaches in isolation, for example, the split between the first and second pillars of the current EU rural development regulations and the way in which national/regional government departments are structured to deliver on specific themes (for example, the traditional separation of 'food', 'agriculture' and 'environment'), then it is likely that the interaction between activities and the synergy that could result from that will be lost. Where it does make sense for this type of compartmentalisation of activities for other reasons, then specific efforts need to be made to ensure cross-departmental communication. These initiatives can be supported by increased engagement with a broad range of stakeholders, including both industry and civil society.

CONCLUSIONS

Over the last two decades, agri-environmental measures have become increasingly important in OECD countries, with significant public resources being spent on them. Across OECD countries, a very wide range of different schemes have been implemented and there is as yet little consensus concerning which approach works best. Increasing pressure on financial resources means that there is now an increased emphasis on:

- **More direct linking of payments to public goods** (positive externalities and ecosystem services);
- **Better specification of the ecosystem services** to be delivered and better monitoring that delivery has taken place;
- **Improved cost-effectiveness of schemes**, including reducing the potential for 'over-payments' to producers and increasing the delivery from available resources;
- **Market-led solutions in some countries, with a lesser extent in the EU**.

In terms of the potential relevance of OECD experiences to the development of policies in other countries, the FAO (2010) and Wunder (2005) provide some examples of how PES approaches have been implemented in developing countries. Wunder identifies many issues arising from current experience implementing PES schemes in developing countries with many of the examples either being business or aid-agency led, in contrast with the government-led approaches to agri-environmental measures adopted in most OECD countries. However, some of the more market-oriented countries, such as the USA and New Zealand, share more similar experiences.

With sufficient resources, almost any policy measures or combination of public- and private-sector support could be considered. Where resources are limited or infrastructure inadequate, alternative options may need to be prioritised. However, building on the OECD experience, the following issues may be relevant:

- **A focus on public good outputs and output targets** is to be welcomed, provided that potential interactions with other policy aims and instruments are recognised and conflicts/ unintended side-effects are avoided.
- **An appropriate regulatory and/or environmental cross-compliance framework** is needed to minimise the possibility of negative externalities, promote the 'polluter pays' principle and provide a baseline on which to build PES schemes.
- **Land tenure and land-use rights** also need to be considered: OECD models include direct land ownership and control (not necessarily by the public sector), land ownership managed by tenants under conditional agreements and covenants linked to the property title deeds. There may be scope for land reform policies to treat externalities and the provision of ecosystem services separately from other land-use rights, but this needs to be addressed specifically in such debates.

- **Selection of monitoring indicators** is required, particularly where specific land-use systems are believed to contribute single or bundled ecosystem services. The direct linkage between specific land-use practices and specific ecosystem services need to be well identified and understood in different agro-ecological conditions.
- Specific land-use systems in pursuit of multiple objectives may be considered economically inefficient due to the potential for over-delivery of some outputs; the **combination of systems-based approaches with more targeted measures** can be more cost-effective.
- Payments need to be made upon **conditionality** of the delivery of specific ecosystem services and delivery needs to be ensured prior to payment, but other mechanisms are needed to ensure delivery if a specific land-use system is being supported.
- Alternative mechanisms, such as **auctions and other participatory mechanisms**, for establishing payment rates may need to be explored to avoid over- or under-compensation in order to achieve specific targets, although account also needs to be taken of the weaknesses of these approaches.
- Schemes need to be supported by **appropriate training**, advice and other extension activities. Improving producer skills, understanding and engagement is a key mechanism to ensuring effective use of resources and potentially to increase the quantity of public goods that can be purchased for a fixed amount. While OECD schemes typically provide for such activities, the level of resources allocated is generally low and consideration should be given to significantly increasing the share of resources allocated to extension work.
- The success of Landcare schemes in Australia and some catchment schemes in Europe also indicates that **group approaches**, involving peer-group pressure and mutual learning, may be worth considering and highly relevant in circumstances where the legal/administrative relationship between individual producers and the relevant agencies is less formal.
- **Transaction costs**, both for the implementing agency and the producer, can be very high in schemes that are highly customised to the individual holding — a compromise between the principle of payments for public goods, the accuracy of specifying and monitoring service delivery and the transaction cost may be necessary.
- **Certification schemes** for land-use systems that are considered to deliver ecosystem services (e.g. organic, Rainforest Alliance) may be used to verify compliance with a PES scheme, reducing transaction costs if linked to appropriate marketing opportunities. In order to reduce transaction costs and burdens on producers, multiple visits that duplicate control functions should be avoided (see also Chapter 5 "Social and cultural drivers behind the success of PES").

REFERENCES

Cooper, T., Hart, K. & Baldock, D. 2009. *The provision of public goods through agriculture in the European Union*. Report Prepared for DG Agriculture and Rural Development, Contract No. 30-CE-0233091/00-28. London, Institute for European Environmental Policy.

EC. 2009. *Why do we need a Common Agricultural Policy?* Discussion paper. Brussels, DG Agriculture and Rural Development, European Commission.

EC. 2010a. *Europe 2020 – A European strategy for smart, sustainable and inclusive growth*. COM (2010) 2020. Brussels, European Commission.

EC. 2010b. *The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future*. COM (2010) 672 final. Brussels, European Commission.

OECD. 2009. *Agricultural policies in OECD countries – Monitoring and evaluation 2009*. Paris, Organisation for Economic Co-operation and Development.

Schader, C. 2010. *Cost-effectiveness of organic farming for achieving environmental policy targets in Switzerland*. Forschungsinstitut für biologischen Landbau (FIBL), Frick, Switzerland. (Ph.D. thesis)

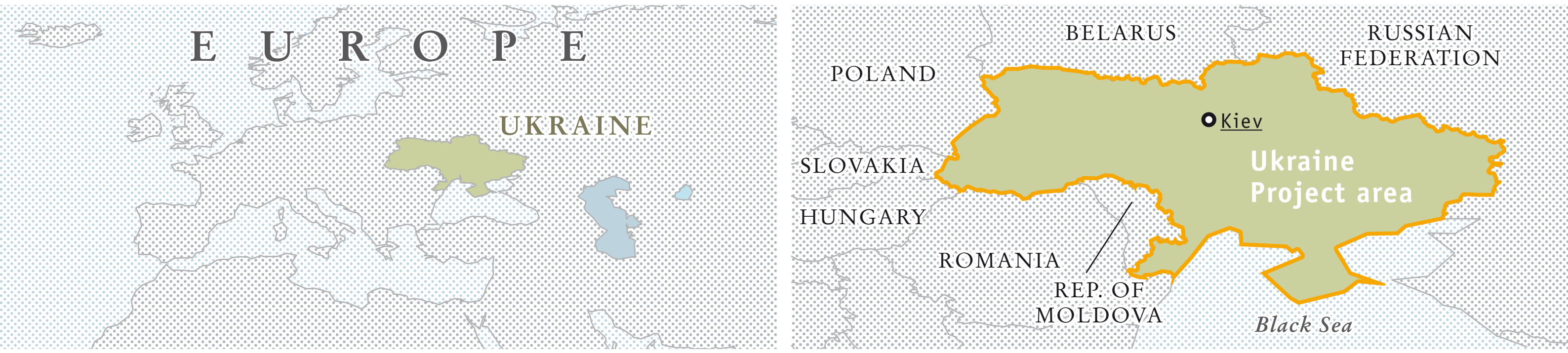
USDA. 2009. *Conservation policy briefing room: Background*. Washington, D.C., Economic Research Service, U.S. Department of Agriculture (available at http://www.ers.usda.gov/Briefing/ConservationPolicy/background.htm).

Wunder, S. 2005. *Payment for environmental services: Some nuts and bolts*. Jakarta, Centre for International Forestry Research (CIFOR).

GEOGRAPHICAL INDICATION (GI) CERTIFICATION IN UKRAINE

Oksana Osadcha, Viktor Teres and Yuriy Bakun
International Charitable Foundation "Heifer Project International", Kiev, Ukraine

© A. Karnaukh



A study was conducted in 2009-2010 by Heifer International (Heifer-Ukraine) under the financial and conceptual support of the FAO to highlight the potential to promote geographical indication (GI) certification of some traditional food products in Ukraine. The process revealed some major constraints in the existing legal framework on GI certification and a lack of harmonisation with EU legislation.

Ukraine Law No. 752 on Geographical Indications, adopted in 1999, provides a legal basis for the protection of the rights to indicate the origin of goods, but this legislation lacks a clear distinction between the definitions of the Protected Denomination of Origin (PDO) and the Protected Designation of Geographic Origin (PGI). The application for GI certification has to be reviewed and cleared by a competent state body before being submitted and a fee of about €100 has to be paid. However, the legislation does not cover some fundamental aspects of GI certification, such as the identification of criteria to provide description, specification and reputation of the GI products, as well as the standards or protocols for their production. Prior review of the application and certification is done by different state bodies with no clear coordination between them. Furthermore, once the certificate is issued, there is no system of control in place that can monitor the compliance of the GI certification with its specification requirements.

Above all, the present legislation restrains any possibility of collective action and community-based initiatives aimed at rural development and the promotion of traditional and local food products. In other words, while it allows a single producer to individually obtain GI certification for a certain product, it prevents groups of producers to apply for such certification collectively. This at least partly explains why the sole Ukrainian product to have received GI certification is bottled mineral water where only a single producer/company is involved. Another reason of the low activity of producers in registering their products is poor awareness about GI certification in general.

Nevertheless, being an important producer of cereals, fruits, oil seeds and dairy products, Ukraine has great potential to introduce several traditional GI-certified food products to the market and the circuit of rural gastronomic tourism.

Heifer-Ukraine interviewed 1 000 consumers, sampled from ten different administrative Ukrainian regions, as well as 300 small and medium-sized producers to identify a shortlist of potential products suitable for GI labelling and people's attitudes towards GI certification. Potential GI candidate products include sweet onions from the Yalta region (*tsybulya "Yaltyns'ka"*), watermelons (*kavun*) from the Kherson region, soft cheese (*bryndza*) from the Zakarpattia region and fruit jam from apples (*doneshta variety*) from the Kamyanka and Vinnitsa regions (Figure 6). The investigation further revealed that people generally have little knowledge about the traditional and local products of the various Ukrainian regions and about the GI certification process. They believed that public policies should promote local products and give financial support for their production. Thus, this example clearly shows how poor legislation and policies at the national level determine the lack of knowledge and interest amongst both consumers and producers. As a consequence, farmers cannot make use of the potential of GI certification for additional income generation.

REFERENCES

Bakun, Y., Teres, V. & Osadcha, O. 2010. *Study of potential origin-linked quality food products and their demand in Ukraine*. Final Report Project TCP/UKR/320 – SEU- LoA/10/004.

Teres, V., Osadcha, O. & Bakun, Y. 2010. *Opportunities for remuneration for positive externality development in Ukraine as a booster of income generation.* Poster presented at the FAO stakeholders consultation on Food Security through Additional Income: From PES to the Remuneration of Positive Externalities in the Agricultural and Food Sector, 27–28 September 2010, Rome, Italy.

Current pages (from left to right):

→Ukraine has a strong tradition of agriculture and agricultural land per capita is higher than the EU average.

→Children drinking milk in the rural settlement of Samiilychi in Volyn oblast, Ukraine.

→In Ukraine, a law was adopted in 1999 for the protection of the right to indicate the origin of goods; however, no traditional food products have been registered yet.

Figure 6

Selected study areas linked to possible geographic certification of local products

LEGEND

Project site areas with potential certification of local products

Adapted from original map by Oksana Osadcha (Heifer Project International)


RESERVE
AU
BIO

CHAPTER

3

OPPORTUNITIES AND GAPS IN PES IMPLEMENTATION AND KEY AREAS FOR FURTHER INVESTIGATION

Daniela Ottaviani
Food and Agriculture Organization of the United Nations, Rome, Italy

CONTENTS

ABSTRACT

Payment for Ecosystem Services (PES) is often considered a simple market tool conceived to reflect the value of positive externalities related to the provision of ecosystem services. Having a clear economic structure the performance of PES programmes is often evaluated by economic criteria, such as additionality, economic efficiency, conditionality, leakage and permanence of benefits. However, emphasis on the economic structure of PES schemes has often hidden the ecological and social dimensions that are linked the fundamental purpose of PES.

The understanding of positive relationships (synergies) and negative interactions (trade-offs) occurring amongst the multiple ecosystem functions is key to designing PES schemes that are more efficient in the delivering ecosystem services for society. Ecosystem services have a social value because they are natural capital belonging to the whole of society. Reflecting the value of ecosystem services is likely to involve different stakeholders at the local, regional and global scales, which can lead to social debate and conflicting views. PES should, thus, reflect societal preferences, which are not just the sum of individual preferences; reflecting societal consensus should be completely driven by a participatory approach. Although PES was not originally conceived as a tool for poverty alleviation, some elements of PES design can increase the potential for this. As such the possibility of implementing community PES programmes seems a major opportunity for the new generation of PES schemes in which all community members could receive some benefits.

Integrating economic, ecological and social criteria in PES design and implementation will certainly increase its complexity, but this integration could lead PES to support sustainability by promoting economic resilience, environmental integrity and social development.

PES: BEYOND A SIMPLE MARKET TOOL

PES schemes have a clear economic structure constituted by voluntary contractual agreements that define economic transactions between a buyer and a seller for the provision of ecosystem services. Due to this economic structure, PES is often thought of as a simple economic incentive that is operated and regulated by economic principles and market rules. This emphasis on the economic dimension has often hidden the ecological and social dimensions of PES schemes though. However, it is the ecological and social dimensions that are expressed in the fundamental purpose of PES: to preserve the functioning of ecosystem services for the well-being of society. Integrating the multiple dimensions of PES requires consideration of different criteria, inputs, processes and a different level of dialogue.

Integrating the multiple dimensions of PES requires consideration of different criteria, inputs, processes and levels of dialogue

Costanza and Folke (1997) point out that, in the economic dimension, PES schemes require only a low level of scientific input and discussion amongst stakeholders to achieve economic efficiency. In fact, the definition of a market value for the ecosystem services can be assessed according to individual preferences, which do not require agreement or social consensus. Moreover, the market value can simply reflect individually perceived opportunity costs, which do not necessarily require an understanding of the biophysical linkages in the ecosystem functioning.

On the contrary, in the ecological dimension, PES schemes need a high level of scientific input if they aim to conserve or restore ecosystem services (Kremen, 2005). The highly specialised nature of this input will require a certain degree of filtering and simplification through the use of modelling and scenarios to be able to be shared and discussed amongst stakeholders coming from different backgrounds.

In the social dimension, PES schemes need a medium level of scientific input that constitutes the background information needed to set up an active participatory social debate (Costanza and Folke, 1997). However, intensive dialogue will be required to define equity and justice criteria for the distribution of resources and property rights both with the current and future generations.

By considering the multidimensional nature of PES in the first section of this chapter, it is seen that the main economic attributes of PES are often detrimental to the expression of the ecological and social dimensions. In particular, the assumptions upon which PES schemes are based that define current market-based criteria for PES performance are critically reviewed. In the next section, the importance of ecosystem processes and functions for the provision of ecosystem services will be revisited. The importance of market restrictions for natural resources and the need to assess and model the provision of multiple ecosystem services is highlighted. In the third section of this chapter, the value of ecosystem services for society and the different perspectives of stakeholders at the local, regional and global scales will be looked into. Finally, the potential of PES for poverty alleviation and important factors that might be crucial in the next generation of community-based PES schemes are discussed.

UNDERLYING ECONOMIC ASSUMPTIONS OF PES

The economic rationale of PES as a market tool that provides positive incentives to ensure the delivery of ecosystem services to society mainly reflects different principles of a neoclassical economic framework. These principles include the utilitarian anthropocentric principle, market essentialism and consumer choice theory, and the optimistic predictions of the Coase Theorem[1] (Coase, 1960).

1 The Coase Theorem states that when private property rights are clearly defined by enforceable contracts, then the supplier and buyer of an externality can, through voluntary exchange, potentially reach an agreement that maximises social welfare.

All ecosystem functions are considered ecosystem services only if there are people that can benefit from their delivery. This utilitarian principle also brings the idea that ecosystem services have an economic value only if people consider them valuable and are willing to pay for them. According to market essentialism, markets, surrogate markets and simulated markets are the ideal institutions for the efficient allocation of resources that will adequately quantify the monetary value of public goods and signal their scarcity through price fluctuations.

Within the market mechanism, individuals are expected to behave according to the consumer choice theory under which: (a) individuals are mainly self-interested and act as rational actors to maximise the utility (i.e. satisfaction of their preferences); (b) they can make rational choices because their decisions are based on complete information and reliable forecasts on the likelihood of possible outcomes; (c) they have a single, stable, invariant set of preferences, which are internally consistent and structured; and (d) they have preferences whose strength can be measured by their willingness to pay (WTP) for a degree of satisfaction or a willingness to accept compensation (WTA) for benefits forgone (Chee, 2004). The optimistic attitude towards PES schemes is also based on the Coase Theorem, which states that when private property rights are clearly defined by enforceable contracts, the supplier and buyer of an externality can then, through voluntary exchange, potentially reach an agreement that maximises social welfare. However, Coase (1960) himself argued that this outcome will only occur in the absence of wealth effects and transaction costs (Chee, 2004).

Neoclassical economic frameworks do not reflect complexity of socio-economic contexts or the drivers underlying individual choices

It is clear that these economic assumptions often do not reflect the complexity of socio-economic contexts, nor the diversity of drivers underlying individual choices. This gap can be counterbalanced though when the ecological and social dimensions are fully tackled by PES schemes. In this case, the disruption of ecosystem services will not be expected to be signalled only by price fluctuations; instead, there will be a robust scientific background to provide scenarios for policy and decision making. At the same time, the participatory nature of the social dimension of PES will enhance stakeholder dialogue and allow societal preferences to be born and negotiated, eventually resulting in community consensus and collective action.

CURRENT MARKET-BASED CRITERIA OF PES PERFORMANCE

Five criteria are generally used to evaluate economic performances of PES programmes including: (a) additionality, (b) economic efficiency, (c) conditionality, (d) leakage, and (e) permanence of benefits.

a. **Additionality** requires that any change/improvement/adoption of a different practice should be additional to the scenario that would have occurred in the absence of the PES project. To lack additionality means that PES programmes are paying for something that would have been adopted anyway, which results in poor financial efficiency. Therefore, projects must demonstrate actions over and above 'business as usual'. This additionality criterion also implies that, in the valuation of multiple ecosystem services, 'double counting' should be avoided as creating uncertainty and poor reliability of the valuation. Because ecosystems always provide multiple ecosystem services the most common approach is to try to value single ecosystem services independently and then add all the obtained values together to obtain the total monetary value of ecosystem services in the ecosystem. Fu *et al.* (2010) suggest different measures to reduce the probability of double-counting though. However, additionality seems an inappropriate standard when dealing with ecosystems, which are constituted by multiple non-linear interactions amongst ecosystem services.

b. **Economic efficiency** (i.e. the optimal allocation of resources) in PES involves maximising the differences between benefits and costs, where benefits are those obtained from the provision of ecosystem services and costs include opportunity costs of individual land properties, information and transaction costs. In particular, economic efficiency is often challenged by the difficulty of pinpointing the true opportunity cost. This is caused by the asymmetric information between the seller and the buyer of ecosystem services (i.e. while the seller of ecosystem services knows the opportunity costs given by the land he owns, the buyer does not know what the lowest price is at which the seller would be willing to accept the offer and engage in a PES scheme). PES programmes are considered economically inefficient when they pay more than the landowner's true opportunity cost.

c. **Conditionality** is a performance criterion upon which the definition of a PES contract is based. In fact, payment should be provided upon condition that the provision of the ecosystem service has been delivered. Due to the voluntary nature of PES agreements, it is assumed that any failure to meet the expected conditions (i.e. a lack of conditionality) will determine the end of the contractual agreement. In fact, according to the neoclassical economic framework, once a voluntary market agreement is established it reflects the highest goods for both the seller and buyer. In reality, conditionality is assumed but seldom verified, with serious consequences for the real evaluation of PES performance. When buyers are not direct users (e.g. in public-financed PES schemes), they do not have first-hand information and have little direct incentive to ensure that the programme is working efficiently. In addition, public-financed PES can be subject to a variety of political pressures.

d. **Leakage**, otherwise known as spillage, refers to the inadvertent displacement of activities damaging ecosystem services provision to areas outside the geographical zone of PES intervention (Robertson and Wunder, 2005). Leakage may occur directly, for example, if landholders engaging with PES for the protection of forests on their lands shift deforestation activities to other areas. Leakage may also occur indirectly through market mechanisms, for example, land enrolment in PES for forest conservation may lead to increased prices of forest products, thereby encouraging extractive activities in other forest areas.

e. **Permanence of benefits** refers to the ability of a PES programme to achieve long-term improvements in ecosystem service provision, including beyond the period of the payments. Sometimes permanence is suggested as a criterion of PES performance. However, this criterion assumes a degree of stability of the *status quo* both on the ecological and socio-economic dimensions. From the ecological perspective, given that ecosystems are composed of multiple interacting ecosystem services, the stability of a certain ecosystem function cannot be expected over time due to unexpected disturbances and interventions that may occur via other interlinked ecosystem functions. Even if ecosystem complexity is excluded and a single ecosystem service is considered, the lack of ecological criteria in the PES design often hampers the ecological permanence of benefits. In absolute terms, ecological permanence in the delivery of ecosystem services cannot be expected given the high rate of catastrophes, the subtle ongoing changes currently affecting the planet and the many demands and ecological pressures placed on land. Socio-economic permanence in the delivery of ecosystem services is also not likely to occur unless PES initiatives are driven by strong individual and community motivational drivers. In fact, PES is considered an advanced market tool with a flexible structure, being a voluntary transaction based on a conditional agreement and, thus, able to adapt to political, economic and social changes. In principle, participants in PES programmes cannot be expected to continue to respect the contractual agreement once the payment is over. Numerous studies show that when people receive a monetary payment for doing something they would have done anyway, their motivation for doing it without payment diminishes; they also do it less well if they perceive the payment as inadequate and they may stop doing it altogether when payment ceases (Farley and Costanza, 2010).

MAINTAINING THE FUNCTIONING OF ECOSYSTEMS: THE ECOLOGICAL DIMENSION OF PES

The provision of services from an ecosystem depends on complex processes that must be recognised in the design of PES. The structure and composition of ecosystems will profoundly affect the provision of ecosystem services, such as water purification, carbon sequestration and pollination (see Viewpoint 3 “PES design: Inducing cooperation for landscape-scale ecosystem services management"). Understanding the characteristics of ecosystems that need to be preserved to maintain ecosystem functionality is an important first step towards incorporating these elements into PES design.

As described by Moss (2008), undisturbed natural ecosystems are characterised by a high level of resilience; they are self-maintaining, requiring no human management. Ecosystem resilience is linked to the preservation of ecosystem structure, size, connectivity and balance of chemical nutrients (Moss, 2008). Ecosystem structures include both physical (geomorphological features, tree debris, etc.) and biological components (food webs, keystone species, etc.); landscape connectivity, including both the spatial continuity between landscape elements (structural connectivity) and the response of individuals to landscape features (functional connectivity). Ecosystem size refers to occurrence of a sufficient area likely to include a sufficient variation in biological diversity, which will be able to cope with inevitable fluctuations in ecosystem conditions. A balanced amount of chemical nutrients is a property of a well-preserved ecosystem, which is commonly characterised by parsimony of available nutrients because most of them are tied up in the biological component and tightly recycled. Thus, an undisturbed natural ecosystem maintains its functionality because its size, structure and connectivity support a sufficient diversity of life forms that are able to efficiently recycle nutrients and ensure a balanced flow of matter and energy through the ecosystem. In summary, as suggested by Wallace (2007), the structure and composition of ecosystems highly influences ecosystem processes.

Ecosystem resilience is linked to the preservation of ecosystem structure, size, connectivity and the balance of nutrients

BIODIVERSITY: A KEY ATTRIBUTE OF ECOSYSTEMS NEEDED FOR THE PROVISION OF SERVICES

Biodiversity is a key attribute of ecological systems having a fundamental role in ecosystem functioning and, thus, in the provision of benefits to society or services (TEEB, 2009). Functioning is constituted by all the ecological processes controlling the fluxes of energy, nutrients and organic matter in the ecosystem. These fluxes are developed and regulated through the web of living organisms, which take in energy and substances, grow, reproduce, die and are decomposed back into the fluxes of organic matter, energy and nutrients throughout their life cycle. Thus, ecosystem functioning is based on primary production, decomposition and nutrient cycling. Every species is considered as having a unique ecological niche and consequently a higher number of species in a community should be able to more efficiently use resources, produce more biomass and show more resilience and adaptation to environmental changes than a community with a lower degree of biodiversity (Loreau *et al.*, 2001; Tilman, 1996).

Biodiversity loss occurs at different scales: locally as species richness decreases in biological communities and globally as the rate of species extinctions increases on the planet. The main direct drivers of biodiversity changes are habitat change, climate change, invasive species, over-exploitation, unbalanced nutrients and pollution (Sala *et al.*, 2000). The current increasing rate of biodiversity loss has raised some concerns that this might seriously affect ecosystem functioning and, thus, the ongoing provision of ecosystem services (TEEB, 2009).

From the early 1990s, many investigations have been carried out to identify and quantify the amount of biodiversity needed to ensure ecosystem functioning. The aim is to set up experimental conditions that enable a reduction of the number of species in an ecosystem and measure how this loss of diversity impacts key ecosystem processes. However, these findings are mainly constrained by three factors: (a) experiments are mostly carried out at a small scale and in over-simplified environments; (b) they mainly focus on only one component of biodiversity, which is easy to manipulate (e.g. terrestrial plants or algae); and (c) they often quantify the amount of biodiversity needed for the provision of a single ecosystem process in isolation, while few deal with multi-functionality of ecosystems (see Hector and Bagchi, 2007). The variability amongst the different experimental designs linked to the complexity of this field of investigation has made it very difficult to reach a consensus and a common framework. Recent meta-analyses (Balvanera *et al.*, 2006; Cardinale *et al.*, 2006; Quijas *et al.*, 2010; Schmid *et al.*, 2009, Worm *et al.*, 2006) of this extensive experimental work show the positive effect of biodiversity in the provision of most ecosystem services analysed. They also suggest that the relationship between species richness and many ecosystem functions, such as primary production and water and nutrient cycling, tend to be described by a saturating curve in both terrestrial and aquatic ecosystems (Cardinale *et al.*, 2006; Hector and Bagchi, 2007). The saturating effect is expected as the increased number of species in the community brings an increased overlap of ecological niches amongst species (Schmid *et al.*, 2009) and its main consequence is that the loss of some overlapping species may not decrease ecosystem functioning, but the loss of non-overlapping species will (Loreau *et al.*, 2002).

Fluxes of energy, nutrients and organic matter are developed and regulated in ecosystems through the web of living organisms

Biodiversity has positive effects at a community level and not at a population level; thus, populations are expected to fluctuate more with the increasing number of species in the community, while the species community is expected to record higher productivity and increased stability (Ives and Carpenter, 2007; Tilman, 1996). However, the stability (i.e. resilience) will vary with the type of disturbance taken into consideration. In particular, biodiversity is expected to have different effects on different trophic levels of an ecosystem. When the number of species belonging to one trophic level increases, this has a detrimental effect on the trophic levels below (top-down effect) and above (bottom-up effect).

On the other hand, increased species richness at a trophic level enhances its functionality and benefits symbiont species (Schmid *et al.*, 2009). Some of these predictions were evaluated in both brown (detritus–consumer) and green (plant–herbivore) food webs (Balvanera *et al.*, 2005, 2006; Cardinale *et al.*, 2006, 2009; Duffy *et al.*, 2007; Quijas *et al.*, 2010; Rey Benayas *et al.*, 2009; Schmid *et al.*, 2009; Srivasta and Vellend, 2005; Srivasta *et al.*, 2009). However, responses observed under experimental manipulations of a single trophic level may be more complex and difficult to predict in the real-life scenario of multi-trophic interactions occurring in ecosystems (Duffy *et al.*, 2007).

Some theoretical and experimental work is still needed to quantify in detail the relationship between biodiversity and ecosystem services, such as water quality, water quantity, pollination, regulation of pests and human diseases, carbon storage, climate regulation (Balvanera *et al.*, 2006; Kremen *et al.*, 2004).

Most of the existing experimental evidence focuses on species richness and it is clear that the number of species required to support multiple ecosystem services might be greater than considering a single ecosystem service (Hector and Bagchi, 2007). Moreover, ecosystem services might not be affected only by species richness, but also by species eveness (relative abundance of species) and species composition.

There are still substantial gaps in matching biodiversity components (populations, communities, functional groups, habitat types) to ecosystem functioning (Luck *et al.*, 2009). Thus, working under a precautionary principle fostering biodiversity conservation remains the major insurance facility for ecosystem service provision.

MARKETS FOR BIODIVERSITY: THE NEED FOR MARKET RESTRICTIONS

Around the world, different markets have been established for the trading of natural resources (Table 3). In these virtual markets, a development project that involves the depletion of natural stocks or an alteration of ecosystem processes can buy credits to offset the damage that the project activities will cause and compensate or mitigate these effects with the protection or restoration of an equivalency in a different place.

This trading system is expected to have a neutral effect (no net loss, no net gain) on the overall conservation status of biodiversity. It is clear that this is a simplistic way to approach the challenging target of biodiversity conservation. In particular, there is a fundamental mismatch between the economic principles that regulate common economic markets and the principles that can be applied to biodiversity trading.

Economic market rules require the use of a simple currency and the occurrence of minimal exchange restrictions to be able to build a free dynamic market. Moreover, for efficiency purposes,

Table 3
Examples of current markets of ecosystem goods and services

Resource	Market	Countries
Biodiversity	Biodiversity offsets are recognised in the legal framework of several countries	Australia, Brazil, Canada, Europe, New Zealand, USA
Fish stocks	Individual transferable fishing quota systems	Australia, New Zealand, Canada, Chile, Iceland, the Netherlands
Forests	Reducing Emissions from Deforestation and Forest Degradation (REDD)	Global
Vegetation	Bio-banking and net-gain initiatives	Australia
Water	Tradable permits for saline water discharges according to the Hunter River Salinity Trading Scheme	Australia
Wetlands	Wetland banking	USA

the review of implementation of market activities, if taking place, cannot be onerous. These three attributes of economic markets sharply contrasts with the characteristics of biodiversity markets. First, there is no simple currency able to capture the complexity of biodiversity. What is generally called 'biodiversity' indicates a hierarchical structure of diversity whose range extends from genes to ecosystems. When biodiversity is tackled at the ecosystem level, as in ecosystem services, then all levels of biodiversity are involved (genes, species, populations and communities). This implies that the biodiversity of the ecosystem will be the unique combination resulting from the interaction of the biodiversity recorded at the genetic, species and community levels. Moreover, ecosystem biodiversity is also an emergent property that arises from the combination and interaction of its single constituents. In nature, the possibility of finding an ecological unit which is like another is highly dependent on the appropriate consideration of the scale and the configuration in which the constituents of the unit are assembled. When the inner variability of the system is considered (genetic diversity), together with the variability in the composition (species, population, community diversity) and the interactions and functional linkages of the different constituents (functional diversity) is taken into account, there is no simple currency for biodiversity offsets.

Principles that regulate common economic markets and those that can be applied to biodiversity trading are fundamentally unequal

Although economic principles will foster few market restrictions and free dynamic markets, some market restrictions will be needed for trading biodiversity to minimise potential risks of further biodiversity loss due to market mechanisms. These restrictions arise from the difficulty to identify ecologically equivalent biodiversity offsets and from the current gaps in the understanding of ecosystem complexity.

PRECAUTIONARY PRINCIPLE FOR BIODIVERSITY MARKETS

Based on the discussion on this topic provided by different authors (Bekessy *et al.*, 2010; Gibbons and Lindenmayer, 2007; McCarthy *et al.*, 2004; Moilanen *et al.*, 2009; Norton, 2009; Walker *et al.*, 2009), several criteria to identify possible 'ecologically equivalent biodiversity offsets' are given below:

a. **Ecologically equivalent biodiversity offsets should be based on type, size, space and time criteria**.
   - **Type.** Ecologically equivalent biodiversity offsets should be carefully identified amongst the same species, community or habitat types. In the case of habitats, native vegetation cannot be traded with non-native vegetation, vegetation types cannot be offset with a different vegetation type, a mature vegetation type cannot be traded with newly-planted vegetation, as considerable uncertainty remains on the long-term development for maturity. In the case of species, ecological equivalence should be based on the functional ecological role they have in the community, as well as the species richness of the community and their dominance/rarity. Biodiversity offsetting that considers out-of-kind ('like for the better' or 'trading up') should be evaluated on a case-by-case basis.
   - **Size.** Ecologically equivalent biodiversity offsets should consider size as a quantitative criterion to identify likely species and habitat offsets. In the case of species, population size should exceed the minimum viable population. In the case of habitats, the overall size of the habitat patch and its shape should be considered as influencing the possible number of habitat-specialist species and habitat-edge species.
   - **Space.** Ecologically equivalent biodiversity offsets should consider that complex spatial networks of interactions existing between populations, communities, habitats and ecosystems. When an element of this network is lost, biodiversity resilience might be affected (Hector and Bagchi, 2007; Loreau *et al.*, 2001). Theoretically, ecologically equivalent offsets must replace the natural capital lost with the establishment of physical infrastructure on the territory. Possible suggestions to decrease the effect of the spatial and functional disruption caused by the loss of a habitat patch within the landscape include: identifying equivalent offsets in the same restricted geographical area; preferring nearby replacement habitat patches over distant ones; concentrating replacement in aggregated sites; and weighting the importance of connectivity to local attributes. The use of these suggestions should be evaluated on a case-by-case basis.

- **Time.** Ecologically equivalent biodiversity offsets should consider permanence in time. Destruction is usually permanent, while protection and restoration of certain habitats can be undertaken only for a definite amount of time, making the long-term conditions of the offset uncertain. Ecologically equivalent biodiversity offsets should be protected/restored/realized before assets are liquidated (see Viewpoint 2 "Growing biodiversity banking").

b. Ecologically equivalent biodiversity offsets **should not be measured with composite, additive indices where one combination of attributes can yield the same score/outcome of another (ecologically different) combination of attributes**.

c. Ecologically equivalent biodiversity offsets **should not be used in case of rare biotopes, habitats of threatened species** or in any other case in which trade adds to an already high risk of extinction or loss. Threatened species and habitats should be considered irreplaceable and not interchangeable aspects of biodiversity.

d. Ecologically equivalent biodiversity offsets **will be directed first according to the conservation of existing habitats, followed by the restoration of damaged, altered habitats** and only with the lowest priority to the creation of new habitats.

e. Ecologically equivalent biodiversity offsets **cannot be approved without a rigorous plan of monitoring and compliance which consider long-term horizons** (more than ten years) overseen by an independent authority working for environmental protection.

f. Ecologically equivalent biodiversity offsets **should take into account the uncertainty of outcomes**. Uncertainty arises when the future value may be less than originally estimated, as a result of which some features of conservation value might completely fail to be established/preserved and/or the success/failure of conservation/restoration might vary amongst several sites.

These criteria, based on the precautionary principle, constitute a general framework for biodiversity markets, but they can also apply to biodiversity PES schemes. As an example, Criterion a highlights the importance of identifying what the component of biodiversity is that PES aims to conserve/restore by qualifying the type, size and proper spatio-temporal scales. Criterion b raises the issue on how to measure biodiversity and the risk of using additive indexes, which do not properly consider the functional role of species in the ecosystem. Criterion c suggests that designing a biodiversity PES programme for the protection of rare habitats and endangered species might be not appropriate because, in this case, the critical situation will require concrete and ad hoc measurements of conservation that might leave little space for negotiation with other needs. Criterion d states that the protection of biodiversity should be considered a priority criterion. For example, PES schemes aimed at the conservation or restoration of natural riparian habitats should be highly preferred over using artificial recreation or monoculture plantations.

Criteria e and f consider the importance of ensuring the long-term compliance of biodiversity protection. Thus, PES programmes should be aimed at conserving existing biodiversity, implementing a plan to monitor the status of biodiversity and environmental compliance of the PES agreement. PES design should also consider precautionary measurements to take into account the uncertainty of outcomes, such as biodiversity levels only partially re-established, longer periods required for a full recovery or unintended leakage.

BUNDLING ECOSYSTEM SERVICES

Most of the current PES schemes are based on the delivery of a single ecosystem service and, thus, they are classified as PES in water, carbon sequestration, biodiversity or landscapes.

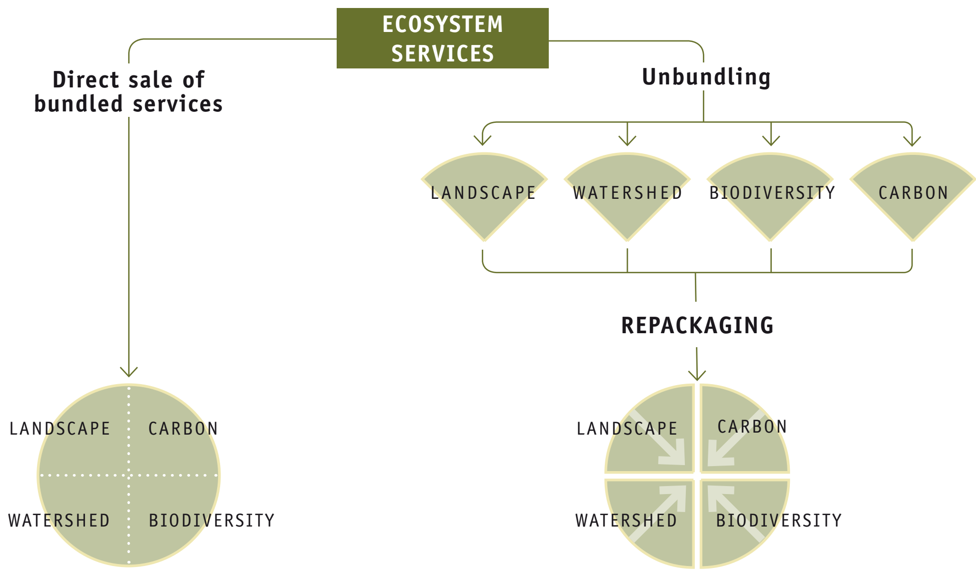
In some instances, instead of considering single ecosystem services, PES projects have considered bundled ecosystem services, for example, in Australia (DSE, 2009), in Costa Rica (Wunscher *et al.*, 2006), in the Danube Delta Region (GEF, 2009), in Colombia, Ecuador and Peru (Goldman *et al.*, 2010), in Kenya (Mwengi, 2008), in Madagascar (Wendland *et al.*, 2010), in Mexico (Muñoz Piña *et al.*, 2008), and the USA (Claassen *et al.*, 2008).

Bundling ecosystem services is commonly understood as a marketing strategy that can be carried out in two different ways: direct sale or the shopping basket (Figure 7). In the direct sale approach, several ecosystem services are sold together as a 'package' and there is no breakdown market analysis of the single ecosystem service components. In the shopping basket approach, however, ecosystem services are initially traded individually and subsequently grouped according to the buyer's needs (Landell-Mills and Porras, 2002). It is clear that the fundamental baseline information needed to sell bundled ecosystem services is the understanding of the relationships occurring amongst ecosystem services in a given location. This implies being able to establish a functional link between agronomic practices and the delivery of different ecosystem services. As an example, in general terms, establishing a riparian buffer can usually enable the delivery of different ecosystem services such as: carbon sequestration, reduction of sedimentation and a decrease of flooding risk. However, this might be a generic and theoretical relationship, while the evaluation of the actual ecosystem in a given location might reveal a more complex network of relationships amongst ecosystem services.

To sell bundled ecosystem services requires an understanding of the relationships amongst ecosystem services in a given location

Ecosystem services interact with each other in a multiple non-linear pathway (Balvanera *et al.*, 2006). There are several typologies of interactions as they can be unidirectional or bidirectional, direct or indirect, with an enhancing or decreasing effect in the provision of the services. To illustrate this conceptual framework, Bennett *et al.* (2009) provide some examples of possible interactions amongst ecosystem services. The level of control of soil erosion can affect water quality (unidirectional-enhancing interaction), while carbon sequestration and tree growth can affect moisture retention (bidirectional-enhancing interaction).

Figure 7
Two approaches to bundling ecosystem services



Adapted from Landell-Mills and Porras, 2002

As ecosystems are complex, ecosystem services will not only interact in a direct way, but their interaction can be mediated by a common driver. A driver is defined as a factor, often directly modified by human management, which affects one or more ecosystem services (Bennett *et al.*, 2009). As an example, wetland restoration (driver) will positively enhance both flood control and water quality (synergy), while fertiliser use (driver) will positively affect crop yield, but negatively affect the provision of water quality (trade-off). Sometimes, a mixed pathway will take place because a driver of change will directly affect one service whose enhanced or decreased provision will, in turn, influence another ecosystem service. For instance, the restoration of riparian wetlands (driver) can enhance flood protection (regulating service), while flood protection can ensure downstream crop production (provisioning service).

Ecosystem services interact with each other in multiple non-linear pathways which affect the provision of those services

In many instances, ecosystem services are affected when ecological principles are not used in ecosystem management. For example, the relationship that exists between afforestation and water supply will vary depending on the tree species used. Usually, the loss of riparian vegetation allows run-off to enter the waterways, carrying with it debris and a variety of other materials, which are likely to decrease water supply and quality (Sweeney *et al.*, 2004).

Interestingly, the same tree species can have opposite effects if planted in areas where it is not native, as opposed to where it is native. When an upper watershed is afforested with native *Eucalyptus* trees, as in the case of New South Wales in Australia, the water supply function can be restored in the ecosystem with the additional advantage of carbon sequestration. In contrast, when *Eucalyptus* trees are introduced to a different ecoregion and are used for the same purpose, as in the case of the Argentinian *pampas*, deep-rooted *Eucalyptus* trees are able to reach groundwater supplies, diminishing the overall water supply (Jackson *et al.*, 2005).

Understanding if ecosystem services interact directly or indirectly through the occurrence of a common driver of change is fundamental for sound management. In human-modified ecosystems, the management of ecosystem services is aimed at increasing synergies and decreasing trade-offs amongst ecosystem services. In situations in which a driver of change strongly affects two different ecosystem services that do not strongly interact with each other, addressing the driver is expected to have an effect on both ecosystem services provision. On the contrary, if the interaction is initiated by a driver, but there is a strong negative and bi-directional interaction between the two ecosystem services (trade-off), managing the driver is unlikely to have any substantial long-term effect (Bennett *et al.*, 2009). As shown in the Millennium Ecosystem Assessment (2005), the benefits of managing ecosystems in a sustainable way exceeded the benefits associated with ecosystem conversion. Thus, in Canada, an intact wetland has a higher economic value than the value obtained if the wetland is converted to intensive farming; in Cameroon, sustainable tropical agroforestry has a higher dollar value per hectare than small-scale farming; similarly, in Cambodia, traditional forest use is more advantageous than unsustainable timber harvest; and, in Thailand, intact mangroves convey ecosystem services for an overall economic value higher than shrimp farming. This is because in the economic evaluation of the total ecosystem value both marketed and non-marketed ecosystem services are considered. Sustainable management of ecosystems should be based on the understanding of possible synergies and trade-offs amongst ecosystem services, which should also be the key information for designing PES schemes.

SPATIAL PATTERNS OF PROVISION OF MULTIPLE ECOSYSTEM SERVICES

Mapping the provision of ecosystem services poses several challenges. The first challenge is linked to the fact that landscapes are heterogeneous with an uneven spatial distribution of goods and services. Within this biophysical variation there is also variation of land use and land management. The second challenge is linked to the fact that different ecosystem services might be characterised by different spatial patterns.

As described by Karoukakis (see Chapter 4 "Cost-effective targeting of PES"), a spatially explicit analysis that compares the occurrence of different ecosystem services can be a useful tool to identify key areas for ecosystem service provision and PES implementation. The simpler way to represent the spatial occurrence of ecosystem services is to associate them to a certain land cover/use. When the study area is spatially delimited and described by a land cover typology, the use of coefficients that express the monetary value of ecosystem services in each cover type might be transferred from other research investigations and used to compute a total ecosystem service value by cover class in the study area (Troy and Wilson, 2006).

Landscapes are heterogeneous and biophysically uneven, as well as having variation in land use and management

This approach, often described as 'value transfer' or 'benefit transfer', was developed to overcome a lack of data, decrease time and costs for evaluation of ecosystem services provision and to develop global scenarios (Costanza *et al.*, 1997; Troy and Wilson, 2006). However, 'value transfer' has been heavily criticised for neglecting potentially important spatial differences that are likely to be found amongst different study areas, different spatial scales and different habitat patches. The assumption that every hectare of a given land cover has a fixed value does not take into account rarity, spatial configuration, size, quality of habitat, type of environmental management, number of resident people, social preferences and motivational attitude towards the preservation of ecosystem services (Tallis and Polasky, 2009). Moreover, the value transfer approach does not consider any change in value of ecosystem services with time (Nelson *et al.*, 2009).

By contrast, the open-source Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) is based on ecological and economic production functions (Nelson and Daily, 2010), rather than benefits transfer. These production functions define how an ecosystem's structure and function affect the flows and values of ecosystem services. InVEST uses these functions to map the geographic distribution of several ecosystem services, such as water pollution regulation, carbon storage and sequestration, and sediment retention. First, InVEST quantifies biophysical supply (e.g. sediment retention, soil retention capacity), then it maps spatial distribution of ecosystem service (e.g. avoided sedimentation of a reservoir) and, lastly, it can provide economic or social values of the service provided (e.g. avoided cost of sediment removal) (Tallis *et al.*, 2010). To calculate ecosystem service outputs, biophysical outputs are combined with data on demand, such as existing number of beneficiaries and/or the intensity of the demand linked to human activities. The value of the service is estimated through an assessment of cost savings, net present value and other economic methods.

InVEST is scenario driven. In other words, stakeholders can define scenarios for particular land-use/land-cover changes, and trade-offs can be measured through modelling and mapping the provision of multiple ecosystem services under these alternative futures (Nelson *et al.*, 2009). Mapping multiple ecosystem services under present and feasible future conditions makes it possible to assess trade-offs and synergies among ecosystem services and determine how policies and land-use decisions will impact natural capital. However, map comparison has drawbacks. Finding a spatial accordance between two ecosystem services could be difficult to interpret given the approximation introduced by the use of proxy variables to model ecosystem services, uncertainty about accuracy and precision linked to the scales and resolutions of input variables, the occurrence of invisible drivers of changes in the mapping resolution and the different possible measures of spatial congruence, such as overlap, coincidence analysis or correlations (Egoh *et al.*, 2009). In particular, a simple map comparison will not reveal the mechanism or activity through which ecosystem services could be functionally bundled and this lack of information might lead to poor decision-making.

A second drawback is linked to the interdependence between ecological and socio-economic systems. Social factors, such as population density, wealth and increasing economic development, often constitute drivers of change in the ecosystem functioning. Thus, assessing the relationship among multiple ecosystem services with an integrated socio-ecological approach is likely to provide more realistic outputs and the possibility to evaluate existing relationships among ecosystem services against different scenarios of socio-economic changes (Bennett and Balvanera, 2007; Bennett *et al.*, 2009).

Raudsepp-Hearne *et al.* (2010) have suggested a multivariate statistical approach to identify and map bundles of ecosystem services that repeatedly appear together in space amongst municipalities. This heuristic approach, while not investigating the mechanism through which ecosystem services are linked together, can spatially identify situations in which synergies amongst ecosystem services are detected. In this study, only some of the municipalities, characterised by similar levels of crop production, show a severe degradation of other ecosystem services, as measured as soil phosphorous retention, soil organic matter and drinking water quality. This highlights that severe trade-offs between provisioning services (crop production) and regulating services are not always inevitable, but might be driven by policies, environmental awareness and sound management strategies.

In conclusion, spatial explicit modelling tools are often used to generate maps, to create scenarios of change, to provide inputs for discussion amongst stakeholders and to disentangle and understand better bundles of ecosystem services. However, the interpretation of these outputs should always consider the limitations of ecosystem modelling related to the present scarce knowledge of ecosystem functioning (e.g. identification of the threshold at which the functionality of ecosystem services collapse, and understanding of the interactions and feedback loops of ecosystem services amongst multiple spatial and temporal scales).

IMPORTANT ECOLOGICAL CHARACTERISTICS OF PES DESIGN

PES schemes should be designed to reflect important ecological parameters, such as the programme duration, the overall size of area linked to programme, the degree of spatial connectivity and the evaluation of multiple ecosystem services.

- **Duration of the PES programme:** One of the major ecological concerns about PES implementation is the potential disparity between short-term project durations (commonly implemented for about 3-5 years) and the time actually needed to restore and balance the functionality of ecosystems. The time needed to restore ecosystem services will vary according to the biological process involved, such as the vegetation re-growth after reforestation, the time needed for species re-colonisation after local extinction, the time needed to re-adjust population dynamics and community structure after eutrophication and food web modification processes. The conservation and restoration of ecosystem services usually requires a long-term time line. In a review of 89 programmes for the restoration of ecosystem services, the needed time scale ranged from < 5 to 300 years (Rey Benayas *et al*., 2009). However, the long-term durations of PES programmes are often hampered by the need of a continued flow of financing resources. The long-term duration of PES programmes is also obstructed by the voluntary nature of the agreement in which both the supplier and buyer can withdraw from the programme at any time.
- **Size of the area to be covered by PES:** The overall size of the area that will be linked to the PES programme is clearly a critical ecological parameter; ecological processes are usually affected by biophysical thresholds (Ferraro, 2003). As an example, it is estimated that no substantial increase of water quality could be achieved if agricultural use exceeded 50 percent of the entire watershed (Wang *et al*., 1997). Similarly, the occurrence of a vegetated buffer is an important factor influencing water purification and the removal of contaminants. The width of the buffer is critical threshold parameters and different widths will be required for the abatement of different contaminants, such as sediments, nitrogen, phosphorus, pathogens and pesticides (Johnson and Buffler, 2008). The size of the area to be covered by PES will influence not only the abiotic properties of ecosystems, but also its biotic components. A quantitative relationship regulates the number of species (species richness) expected in a given habitat patch of a certain size (Stott *et al*., 1998 versus MacArthur and Wilson, 1967).
- **Spatial connectivity of the area to be covered by PES:** Spatial connectivity is one of the major properties of the landscape that can ensure the long-term survival and persistence of species linked to particular fragmented habitat types. No single population may be able

to guarantee the long-term survival of a given species. Due to demographic stochasticity and the erosion of genetic variability, the smaller the population, the more prone it is to extinction. On the contrary, habitat connectivity will facilitate the establishment of a meta-population structure, constituted by interconnected populations, where emigrants can colonise unoccupied habitat patches or can join a small population and rescue that population from extinction (the 'rescue effect').

- **Multiple ecosystem service covered by PES:** Interactions amongst different ecosystems services are what regulate ecosystems. Thus, even if a PES scheme is designed specifically for the delivery of a single ecosystem services a background assessment should evaluate the possible synergies and trade-offs with other ecosystem services.

THE SOCIAL VALUE OF ECOSYSTEM SERVICES

Ecosystem services have a social value because they are natural capital belonging to the whole of society. Having to include many different perspectives and needs, the total value that ecosystem services have for the society is not restricted to direct use, but enlarges to also include indirect use value and non-use value. While the direct value refers to those benefits provided by a direct interaction between people and ecosystems, such as the provision of goods and services and the enjoyment of ecosystem's beauty through recreational and educational activities, indirect use refers to benefits received indirectly by ecosystem regulating processes. The value of ecosystem services for society can also include non-use value linked to the knowledge that ecosystems continue to exist independently of any possible use (existence value); the awareness that ecosystem services can be enjoyed by other contemporary living individuals (altruistic value); the assurance that ecosystems will be passed on to descendants (bequest value); or the knowledge that ecosystem services will be available for use in the future (option use value) (EFTEC, 2005).

When the total value of ecosystem services is considered it becomes more difficult to assess them in economic terms. Moreover, it can be argued that assigning a monetary value to ecosystem services reduces and distorts their total value. In every society, there are issues that are considered ethically 'untradeable', such as human life, friendship, voting or human organs (Vatn, 2000). Ecosystems, as natural resources, are considered as tradable market goods by some people and as having intrinsic, non-quantifiable and non-market value by others. However, even if a direct valuation in economic terms of ecosystem services does not take place, our preferences/choices/actions might reveal that we are indirectly placing a value on them.

ECOLOGICAL SCALES AND INSTITUTIONAL SCALES

Reflecting the true total value of ecosystem services for society is also challenging because the evaluation should include different stakeholders at the local, regional and global scales (see also Chapter 1 "The role of PES in agriculture"). The definition of the scale at which the ecosystem service is supplied implies the specification of the boundaries of the ecosystem that needs to be taken into consideration and this will affect the identification of the institutional scales that need to be involved (Hein *et al.*, 2006).

In general terms, the functioning of a provisioning service will have a direct impact on its direct use by stakeholders at the local and regional scales, the disruption of a regulating service will affect the indirect use by stakeholders also at the regional and global scales, while all stakeholders at all scales will be involved in the alteration of ecosystem services options and non-use values (EFTEC, 2005).

In reality, the situation is more complex. In fact, the decrease of a single service can impact different stakeholders at different scales. As an example, a significant increase in deforestation could determine a long-term reduction in fuelwood provision for local residents, while the increased logging of commercial tree species will affect timber trade and stakeholders at a regional and global scale. The potential of a single ecosystem service to have an impact at local, regional and global scales depends not only on the nature of the service and the occurrence of existing markets for that service or for the goods provided by the service, but also on the cultural backgrounds, societal motivational drivers and personal belief systems. The evaluation of the total value of an ecosystem service is likely to involve different stakeholders at different scales, which can lead to a negotiation process to resolve conflicting views. Hein *et al*. (2006) point out how taking into account different spatial scales can lead to the identifying of varying preferences amongst different stakeholders directly or indirectly involved in the management of the De Wieden wetlands in the Netherlands. The area is one of the most important peatlands in northwestern Europe and is vital for the supply of provisioning services (fish and cut reeds traditionally used for thatched roofs), recreational activities (an estimated 172 456 visitors per year) and the conservation of biodiversity (water birds, butterflies, dragonflies and a population of reintroduced European otter). At the local level, residents are mostly interested in the benefits that they can receive from the use of available resources, such as fishes and reeds, while at national level stakeholders are mainly interested in the potential of this area for biodiversity conservation. This discrepancy also points out the importance of identifying the appropriate institutional level for decision making. A local management plan driven by the preferences of residents will

Valuing an ecosystem service involves different stakeholders at different scales, with negotiations to resolve conflicting views probably not reflect the conservation value of De Wieden at the national and international levels, while a management plan based on national and international regulations could overlook the economic value of provisioning activities for improving local residents' livelihoods. Considering potentially diverse perspectives of stakeholders at different spatial scales will allow the finding of ways to reconcile varied interests and priorities and to make policies and decisions that reflect the total value of ecosystem services for society.

THE POTENTIAL OF PES FOR POVERTY ALLEVIATION

PES was originally conceived as a market tool and not primarily as a tool for poverty reduction. However, the preservation of the ecosystem services has clear connections with the Millennium Developing Goals (MDG), such as eradicating poverty and hunger (MDG 1), improving health and sanitation (MDG 4, 5, 6) and ensuring environmental sustainability (MDG 7). When PES is designed in a way that seeks to express its potential for the achievement of the MDGs and reduce vulnerabilities of the poor, PES becomes equitable and fully expresses its social dimension (Leimona and de Groot, 2010).

Lessons learned from 15 years of PES implementation have point out possible ways to design PES programmes so as to improve their impact on reducing poverty. However, making PES work for the poor requires a shift in perspective and an open attitude to seek ways to reconcile potentially conflicting goals. Adams *et al*. (2004) provide an excellent framework with which to test attitudes between the preservation of ecosystem services and reducing poverty. When considering the conservation of apes in mountain forests (biodiversity ecosystem service) and poverty, assuming that poverty does not play a role in the dramatic reduction of ape populations in the Congo basin, one would probably simply advocate for strictly-enforced protected areas. On the other hand, considering the poverty conditions in the area as a critical constraint on the success of ape conservation, the implementation of programmes that seek cooperation and discourage people living around such parks from trespassing or hunting in the protected area would be promoted. However, if not only poverty is considered having an effect on biodiversity conservation, but also that ape conservation programmes have a potentially negative impact on poverty, one would try to fully compensate resident people for the associated opportunity costs of the park and turn the interests of local communities to preserve rather than exploit vulnerable ape populations.

PES was originally conceived as a market tool and not primarily as a tool for poverty reduction

It is clear that the last attitude fosters the design of PES programmes, particularly in terms of increasing their potential for poverty alleviation. In this respect, particular attention should be focused on: property rights allocation, abetment of transaction costs, occurrence of a trustworthy intermediate agent, and fair and participatory establishment of the compensation of forgone alternative land uses. These elements in the PES design will enhance the eligibility, interest and ability of poor households to participate in PES programmes (Pagiola *et al.*, 2005).

The most important factor that can prevent the participation of poor people is a lack of land property rights. Thus, when PES programmes promote a clear legal definition of land tenure, this is already an important step in the direction of poverty alleviation as resources and property rights become defined for present and future generations. On the other hand, the poor often own very small parcels of land which will have a limited impact on ecosystem services. Thus, if a simple criterion of additionality is used, the inclusion of poor farmers will undermine a credible demonstration of additionality. In this case, implementing a PES programme at the community level can overcome such constraints and reduce the transaction costs of contracting single individuals. Another advantage of implementing PES programmes at the community level is the possibility of paying rewards to the community in terms of improvements of education or sanitation (construction of school, hospitals, etc.). These non-financial incentives can significantly contribute to improve local livelihoods, especially of landless people who will indirectly benefit from PES initiatives (see also Chapter 6 "Landscape labelling approaches to PES: Bundling services, products and stewards").

Proper PES design can enhance the eligibility, interest and ability of poor households to participate in PES schemes

Another barrier is often represented by the initial cost that poor farmers face when adopting land-use or agronomic practices fostered by the PES programme. Most PES projects consider an initial disbursement to cover these establishment costs (Pagiola *et al.*, 2007) and partly overcome a financial constraint of poor landholders to participate.

Often poor people are also constrained in their ability to participate in PES due to a lack of supportive regulations and/or a lack of skills, knowledge and adequate social network. In this case, the role of an intermediate agent that is trusted and considered reliable by local people is fundamental to representing the interests of poor communities and mediating their perspectives with that of different stakeholders.

Last but not least, poor landholders might not be interested in joining PES programmes because the restriction of future land-use options can be perceived as a too high opportunity cost. Thus, it is important that PES programmes enhance social dialogue and participatory approaches amongst stakeholders to reflect the true opportunity costs perceived by local people. Moreover, PES design should be built with a certain amount of flexibility to be able to adjust to the potential change of opportunity costs over the years.

PROMOTING COMMUNITY PARTICIPATION IN PES PROGRAMMES

PES programmes that aim to promote community participation and enforcement should enhance social dialogue to allow the formation of societal and community preferences, avoid and monitor the surge of conflict or strategic behaviour, be implemented according criteria of equity and social justice and foster collective action.

Societal preferences

The neoclassical economic framework is based on two main unrealistic assumptions: (a) that individual preferences generally remain fixed under all circumstances, and (b) that societal preferences can be expressed as the sum of individual preferences. In reality though, individual preferences change with time and under the influence of education, advertising, variations in abundance and scarcity of goods and services, changing cultural assumptions and specific social and environmental contexts. Moreover, single individuals can have plural identities, showing diverse behaviours in different social contexts, which do not necessarily reflect rational consumer choices (Chee, 2004). The preferences and attitudes of individuals towards public goods and ecosystem services are highly influenced by socio-cultural contexts, learning, knowledge-sharing and social discourse. Thus, participatory processes are essential incubators that allow the formation of social preferences, seed motivational drivers at individual and community level and set the basis for a consensus and collective action (see also Chapter 5 "Social and cultural drivers behind the success of PES").

Participatory processes allow the formation of social preferences, seed motivational drivers and foster collective action

Conflicts and strategic behaviour

Conflicts often arise from a sense of social injustice. Clearly, the establishment of a PES scheme can increase the potential for social conflicts. Conflicts can arise amongst participants in PES programmes and/or between participants and outsiders. The two primary controversial issues are the criteria for property rights allocation and the criteria for defining the opportunity costs and compensation.

Often an indication of a certain level of social conflict is given by the appearance of strategic behaviour. Strategic behaviour is intended to influence the market environment in which it operates to turn the markets to the advantage of the individuals adopting them (see also Chapter 4 "Cost-effective targeting of PES"). In PES schemes, strategic behaviour mainly refers to market operation and speculation to increase the value of the land, ad hoc changes in land use to be eligible for present or future PES schemes, strategic immigration to the area where PES programmes are forthcoming and strategic behaviour in contingent evaluation and bidding rounds for determinations of opportunity costs of their lands (Ferraro, 2001; Ferraro and Pattanayak, 2006).

Criteria of equity and social justice

Equity and social justice are the basis to promoting a sense of community and collective action. PES should be carefully designed if it aims to reflect equity and social justice. In fact, criteria of additionality and economic efficiency may not reflect criteria of fairness and justice.

As an example, Salzman (2005) discusses a virtual scenario in which two farmers own adjacent properties on a slope next to a small river flowing into a reservoir. While five years ago the first farmer, having some environmental concerns, fenced his property to avoid soil erosion and the run-off of nutrients into the stream, the second farmer continued business as usual. If a PES project is set in the area to improve the water quality of the reservoir, an incentive to improve agro-ecological practices is likely to be offered to second and not to the first farmer.

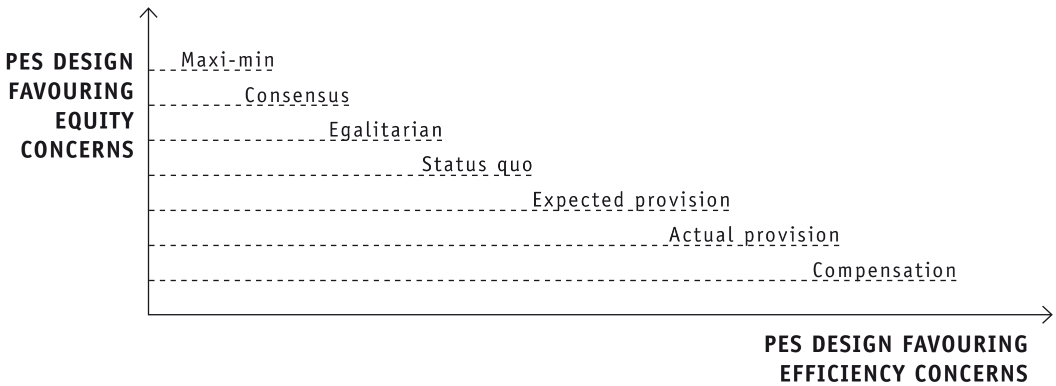
PES schemes reward improvements, not previous efforts made; this rationale often does not promote equity and social justice

In fact, PES schemes are commonly designed to reward an improvement in ecosystem service provision (Salzman, 2005). Under the additionality criterion, PES should reward only additional improvements and not those that would have been adopted anyway. Additionality is considered a pre-requisite to achieve economic efficiency, but this often does not consider consequences on equity and social justice. To overcome this gap and credit the landowners for the ecosystem service provision they have done prior to participation in the programme, some projects have made an initial disbursement, which was not linked to subsequent farmers enrolling into the PES programme (Rios and Pagiola, 2009).

Economic efficiency and equity and social justice can be considered two independent principles that stand on two orthogonal axes and payments can be made according to different criterion that reflect the various degrees and mixtures of economic efficiency and equity (see Figure 8).

At one extreme, payments can be set to optimise economic efficiency and be strictly tailored to the opportunity costs of the different landowners (compensation criterion); at the other extreme, payments can be set to maximise the net benefit to the poorest landowner (maxi-min criterion). Between these two extremes, there are also intermediate solutions (see Table 4). The choice of a given criterion will highly affect the overall performance of a PES scheme. As an example, criteria for calibrated payments that are decided by community agreement (consensus criterion) are likely to promote cooperation, social stability and collective action.

Figure 8
PES design and different emphasis on equity and efficiency criteria



Adapted from Pascual *et al.*, 2009

Table 4
PES design and different fairness criteria

Fairness criterion	Design implications
Maxi-min	Payments aim to maximise the net benefit to the poorest landholders, even at a cost efficiency loss. Payments are differentiated according to the income of providers.
Consensus	Design should promote group decision-making processes to distribute the available funds in a consensus basis. The criteria for payment differentiation are decided by consensus.
Egalitarian	Design should distribute the fund equally among all the providers (per unit of land area, for example), independently of the level and cost of ES provision. Payments are not differentiated.
Status quo	Payments should maintain the previous level of relative distribution of income among providers. Payments are differentiated according to the impact on income equality.
Expected provision	Payments to landholders depend on the expected level of provision of services for a given land use. Payments are differentiated according to the expected provision of ES. These payments compensate landholders to particular land-use changes or practices expected to enhance the provision of ES.
Actual position	The allocation of funds among landowners corresponds to the actual outcome level of provision of ES. Payments are differentiated according to the actual provision of ES.
Compensation	Payments should compensate landholders for the forgone benefits related to the provision of ES. Payments are differentiated according to the cost of provision.

Adapted from Pascual *et al.*, 2009

Collective action

While PES originates as agreements contracted between several single landholders, many lessons learned suggest a potential to shift the contractual agreement of PES from the individual to the community.

Engaging in PES schemes with single private landowners has several disadvantages, including high transaction costs, the reinforcement of competition amongst potentially interested participants in the PES programme, the difficulty of revealing the true opportunity costs in such competitive social contexts and the likelihood of some landholders being against the programme and, thus, acting as ‘free riders’ or opponents to the PES programme.

On the other hand, collective action at the community level will benefit the provision of several ecosystem services. In some instances, ecosystem services have important threshold effects, meaning that if not adopted on a large enough area, the benefits are not realised at all (e.g. the protection of the habitat for some endangered species will be effective only if the area is large enough for a viable resident population). In other instances, ecosystem services can be disrupted if proper management is not adopted by all community members (e.g. a single source of pollution can make the efforts of a large number of actors meaningless).

Lessons learned suggest shifting the contractual agreements of PES from the individual to the community

Collective action can provide several advantages. It might be important in creating collective opposition against unwanted institutional change. In particular, a cohesive community can influence land property allocation or a community residing on public land can foster community user rights (Wunder *et al.*, 2008). Collective action can also strengthen the bargaining power of smallholders, reduce transaction costs, increase cooperation and have greater potential to set up PES schemes that require coordination among neighbouring landowners (Goldman *et al.*, 2007; Parkhurst *et al.*, 2002). In particular, Goldman (2010) describes how the spatial configuration (placement) and composition (type) of native vegetation on agricultural landscapes can be critical to enhancing the provision of different ecosystem services (Viewpoint 3 “PES design: Inducing cooperation for landscape-scale ecosystem services management”).

The main difficulty in generating collective action is that landscapes, by their very nature, are heterogeneous and, thus, not all land or landholders are equally important in the delivery of ecosystem services. As an example, certain areas which include stream banks, steep hillsides and wetlands may need to be managed more carefully than other areas. Furthermore, not all watersheds have the same importance; those upstream of major cities, industries, hydroelectric facilities or other critical water users are likely to receive greater attention.

This implies that even in community-based PES schemes, a calibrated differentiation amongst community members is most likely to be necessary to reflect the true opportunity costs. However, if this evaluation is assessed through the consensus of the community, the contractual agreement of PES could be still made with the whole community and part of the reward could be paid as infrastructure (i.e. non-financial remuneration) for the improvement of living conditions of all the community members.

REFERENCES

Adams, W.M., Aveling, R., Brockington, D., Dickson, B., Elliott, J., Hutton, J., Roe, D., Vira, B. & Wolmer, W. 2004. Biodiversity conservation and the eradication of poverty. *Science*, 306: 1146–1149.

Balvanera, P., Kremen, C. & Martìnez-Ramos, M. 2005. Applying community structure analysis to ecosystem function: Examples from pollination and carbon storage. *Ecological Applications*, 15: 360–375.

Balvanera, P., Pfisterer, A.B., Buchmann, N., Jing-Shen He, Nakashizuka, T., Raffaelli, D. & Schmid, B. 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters*, 9: 1146–1156.

Bekessy, S.A., Wintle, B.A., Lindenmayer, D.B., Mccarthy, M.A., Colyvan, M., Burgman, M.A. & Possingham, H.P. 2010. The biodiversity bank cannot be a lending bank. *Conservation Letters*, 3: 151–158.

Bennett, E.M. & Balvanera, P. 2007. The future of production system in a globalized world. *Frontier in Ecology and in the Environment*, 5: 191–198.

Bennett, E.M., Peterson, G.D. & Gordon, L.J. 2009. Understanding relationships amongst multiple ecosystem services. *Ecology Letters*, 12: 1394–1404.

Cardinale, B.J., Srivastava, D.S., Duffy, J.E., Wright, J.P., Downing, A.L., Sankaran, M. & Jouseau, C. 2006. Effects of biodiversity on the functioning of trophic groups and ecosystems. *Nature*, 443: 989–992.

Cardinale, B.J., Srivastava, D.S., Duffy, J.E., Wright, J.P., Downing, A.L., Sankaran, M., Jouseau, C., Cadotte, M.W., Carroll, I.T., Weis, J.J., Hector, A. & Loreau, M. 2009. Effects of biodiversity on the functioning of ecosystems: Summary of 164 experimental manipulations of species richness. *Ecology*, 90(3): 854.

Chee, Y.E. 2004. An ecological perspective on the valuation of ecosystem services. *Biological Conservation*, 120: 549–565.

Claassen, R., Cattaneo, A & Johansson, R. 2008. Cost-effective design of agri-environmental payment programs: U.S. experience in theory and practice. *Ecological Economics*, 65(4): 737–752.

Coase, R. 1960. The problem of social cost. *Journal of Law and Economics*, 3: 1–44.

Costanza, R. & Folke, C. 1997. Valuing ecosystem services with efficiency, fairness and sustainability as goals. *In* G. Daily, ed. *Nature's services: Societal dependence on natural ecosystems*, pp. 49–70. Washington, D.C., Island Press.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. & van den Belt, M. 1997. The value of the world's ecosystem services and natural capital. *Nature*, 387: 253–260.

DSE (Deparment of Sustainability and Environment, Victoria, Australia). 2009. *EcoMarkets* (available at http://www.dse.vic.gov.au).

Duffy, J.E., Cardinale, B.J., France, K.E., McIntyre, P.B., Thèbault, E. & Loreau, M. 2007. The functional role of biodiversity in ecosystems: Incorporating trophic complexity. *Ecology Letters*, 10: 522–538.

EFTEC (Economics for the Environment Consultancy). 2005. *The economic, social and ecological value of ecosystem services: A literature review* (available at http://tiny.cc/7dg1i).

Egoh, B., Reyers, B., Rouget, M., Bode, M. & Richardson, D.M. 2009. Spatial congruence between biodiversity and ecosystem services in South Africa. *Biological Conservation*, 142: 553–562.

Farley, J. & Costanza, R. 2010. Payment for ecosystem services: From local to global. *Ecological Economics*, 69: 2060–2068.

Ferraro, P.J. 2001. Global habitat protection: Limitations of development interventions and a role for conservation performance payments. *Conservation Biology*, 15: 990–1000.

Ferraro, P.J. 2003. Conservation contracting in a heterogeneous landscape: An application to watershed protection with threshold constraints. *Agricultural and Resources Economic Review*, 32: 53–64.

Ferraro, P.J. & Pattanayak, S.K. 2006. Money for nothing? A call for empirical evaluation of biodiversity conservation investments. *PLOS*, 4: e105.

Fu, B.J., Su, C.H., Wei, Y.P., Willett, I.R., Lü, Y.H. & Liu, G.H. 2010. Double counting in ecosystem services valuation: Causes and countermeasures. *Ecological Research*, 26: 1–14.

GEF. 2009. *Request for CEO endorsement/approval*. Washington, D.C., The GEF.

Gibbons, P. & Lindenmayer, D.B. 2007. Offsets for land clearing: No net loss or the tail wagging the dog? *Ecological Management and Restoration*, 8: 26–31.

Goldman, R.L., Benitez, S., Calvache, A., & Ramos, A. 2010. *Water funds: Protecting watersheds for nature and people*. Arlington, Virginia, The Nature Conservancy.

Goldman, R., Thompson, B.H. & Daily, G.C. 2007. Institutional incentives for managing the landscape. Inducing cooperation for the production of ecosystem services. *Ecological Economics*, 64: 333–343.

Hector, A. & Bagchi, R. 2007. Biodiversity and ecosystem multifunctionality. *Nature*, 448: 188–190.

Hein, L, van Koppen, K., de Groot, R.S. & van Ierland, E.C. 2006. Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological Economics*, 57: 209–228.

Ives, A.R. & Carpenter, S.R. 2007. Stability and diversity of ecosystems. *Science*, 317: 58–62.

Jackson, R.B., Jobbagy, E.G., Avissar, R., Roy, S.B., Barrett, D.J., Cook, C.W., Farley K.A., le Maître, D.C., McCarl, B. & Murray, B.C. 2005. Trading water for carbon with biological carbon sequestration. *Science*, 310: 1944–1947.

Johnson, C.W. & Buffler, S. 2008. Riparian buffer design guidelines for water quality and wildlife habitat functions on agricultural landscapes. *Intermountain West. Gen. Tech. Rep. RMRS-GTR-203*. Fort Collins, CO, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Kremen, C. 2005. Managing ecosystem services: What do we need to know about their ecology? *Ecology Letters*, 8: 468–479.

Kremen, C., Williams, N.M., Bugg, R.L., Fay, J.P. & Thorp, R.W. 2004. The area requirements of an ecosystem service: Crop pollination by native bee communities in California. *Ecology Letters*, 7: 1109–1119.

Landell-Mills, N. & Porras, I. 2002. *Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor*. Instruments for Sustainable Private Sector Forestry Series. London, International Institute for Environment and Development (available at http://www.iied.org/pubs/display.php?o=9066IIED).

Leimona, B. & de Groot, R. 2010. Payment for environmental services: The need for redefinition? *Mountain Forum Bulletin*, 9–10.

Loreau, M., Naeem, S. & Inchausti, P. 2002. *Biodiversity and ecosystem functioning: Synthesis and perspectives*. New York, Oxford University Press.

Loreau, M., Naeem, S., Inchausti, P., Bengtsson, J., Grime, J.P., Hector, A., Hooper, D. U., Huston, M.A., Raffaelli, D., Schmid, B., Tilman, D. & Wardle, D.A. 2001. Biodiversity and ecosystem functioning: Current knowledge and future challenges. *Science*, 294: 804–808.

Luck, G.W., Harrington, R., Harrison, P.A., Kremen, C., Berry, P.M., Bugter, R., Dawson, T.R., de Bello, F., Díaz, S., Feld, C.K., Haslett, J.R., Hering, D., Kontogianni, A., Lavorel, S., Rounsevell, M., Samways, M.J., Sandin, L., Settele, J., Sykes, M.T., Van Den Hove, S., Vandewalle, M. & Zobel, M. 2009. Quantifying the contribution of organisms to the provision of ecosystem services. *BioScience*, 59(3): 223–235.

MacArthur, R.H. & Wilson, E.O. 1967. *The theory of island biogeography*. Princeton, Princeton University Press.

McCarthy, M.A., Parris, K.M., Van Der Ree, R., McDonnell, M.J., Burgman, M.A., Williams, N.S.G., LcLean, N., Harper, M.J., Meyer, R., Hahs, A. & Coates, T. 2004. The habitat hectares approach to vegetation assessment: An evaluation and suggestions for improvement. *Ecological Management and Restoration*, 5: 24–27.

MEA. 2005. *Millennium Ecosystem Assessment. Our human planet: Summary for decision-makers*. Washington, D.C., Island Press.

Moilanen, A., Teeffelen, A.J.A., Ben-Haim, Y. & Ferrier, S. 2009. How much compensation is enough? A framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat. *Restoration Ecology*, 17: 470–478.

Moss, B. 2008. Water pollution in agriculture. *Philosophical Transaction of the Royal Society*, 363: 659–666.

Muñoz Piña, C., Guevara, A., Torres, J. & Brana, J. 2008. Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. *Ecological Economics*, 65(4): 725–736.

Mwengi, S. 2008. *Payments for ecosystem servies in East and Southern Africa: Assessing prospects and pathways forward*. The Katoomba Group.

Nelson, E. & Daily, G.C. 2010. Modelling ecosystem services in terrestrial systems. *Biology Reports*, 2(53): 1–6.

Nelson, E., Mendoza, G., Regetz, J., Polasky, S., Tallis, H., Cameron, D.R., Chan, K.M.A., Daily, G.C., Goldstein, J., Kareiva, P.M., Lonsdorf, E., Naidoo, R., Ricketts, T.H. & Shaw, M.R. 2009. Modeling multiple ecosystems services, biodiversity conservation, commodity production and trade-offs at landscape scales. *Frontier in Ecology and the Environment*, 7(1): 4–11.

Norton, D.A. 2009. Biodiversity offsets: Two New Zealand case studies and an assessment framework. *Environmental Management*, 43: 698–706.

Pagiola, S., Arcenas, A. & Platais, G. 2005. Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. *World Development*, 33(2): 237–253.

Pagiola, S., Ramirez, E., Gobbi, J., De Haan, C., Ibrahim, M., Murgueitio, E. & Ruiz, J.P. 2007. Paying for the environmental services of silvopastoral practices in Nicaragua. *Ecological Economics*, 64: 374–385.

Parkhurst, G.M., Shogren, J.F., Bastian, C., Kivi, P., Donner, J. & Smith, R.B.W. 2002. Agglomeration bonus: An incentive mechanism to reunite fragmented habitat for biodiversity conservation. *Ecological Economics*, 41: 305–328.

Pascual, U., Muradian, R., Rodríguez, L.C. & Duraiappah, A.K., 2009. *Revisiting the relationship between equity and efficiency in payments for environmental services*. Ecosystem Services Economics (ESE) Working Paper Series. 16 pp.

Quijas, S., Schmid, B. & Balvanera, P. 2010. Plant diversity enhances provision of ecosystem services: A new synthesis. *Basic and Applied Ecology*, 11(7): 582–593.

Raudsepp-Hearne, C., Peterson, G.D. & Bennett, E.M. 2010. Ecosystem service bundles for analysing tradeoffs in diverse landscape. *Proceedings of the National Academy of Sciences*, 107(11): 5242–5247.

Rey Benayas, J.M., Newton, A.C., Diaz, A. & Bullock, J.M. 2009. Meta-analysis services by ecological restoration: An enhancement of biodiversity and ecosystem. *Science*, 325: 1121.

Rios, A.R. & Pagiola, S. 2009. *Poor household participation in payments for environmental services in Nicaragua and Colombia*. MPRA Paper, No. 13727 (available at http://mpra.ub.uni-muenchen.de/13727/).

Robertson, N. & Wunder, S. 2005. *Fresh tracks in the forest. Assessing incipient payments for environmental services initiatives in Bolivia*. Jakarta, Centre for International Forestry Research (CIFOR).

Sala, O. E., Stuart Chapin, F., III, Armesto, J.J., Berlow, E., Bloomfield, J., Dirzo, R., Huber-Sanwald, E., Huenneke, L.F., Jackson, R.B., Kinzig, A., Leemans, R., Lodge, D.M., Mooney, H.A., Oesterheld, M.Ì. n., Poff, N.L., Sykes, M.T., Walker, B.H., Walker, M. & Wall, D.H. 2000. Global biodiversity scenarios for the year 2100. *Science*, 287: 1770–1774.

Salzman, J. 2005. The promise and perils of payments for ecosystem services. *International Journal of Innovation and Sustainable Development*, 1(1/2): 5–20.

Schmid, B., Balvanera, P., Cardinale, B.J., Godbold, J., Pfisterer, A.B., Raffaelli, D., Solan, M. & Srivastava, D.S. 2009. Consequences of species loss for ecosystem functioning: Meta-analysis of data from biodiversity experiments. *In* S. Naeem, D.E. Bunker, A. Hector, M. Loreau & C. Perrings, eds. *Biodiversity, ecosystem functioning and human wellbeing. An ecological and economic perspective*. Oxford University Press (available at http://tinyurl.com/5r243d2).

Srivastava, D.S., Cardinale, B.J., Downing, A.L., Duffy, J.E., Jouseau, C., Sankaran, M. & Wright, J.P. 2009. Diversity has stronger top-down than bottom-up effects on decomposition. *Ecology*, 90(4): 1073–1083.

Srivastava, D.S. & Vellend, M. 2005. Biodiversity–ecosystem function research: Is it relevant to conservation? *Annual Review of Ecology, Evolution, and Systematics*, 36: 267–294.

Stott, P., Ward, S.A. & Thorton, I.W. 1998. Equilibrium theory and alternative stable equilibria. *Journal of Biogeography*, 25: 615–622.

Sweeney, B.W., Bott, T.L., Jackson, J.K., Kaplan, L.A., Newbold, J.D. & Standley, L.J. 2004. Riparian deforestation, stream narrowing and loss of stream ecosystem services. *Proceedings of the National Academy of Sciences*, 310: 14132–14137.

Tallis, H. & Polasky, S. 2009. Mapping and valuing ecosystem services as an approach for conservation and natural-resource management. *Annals of the New York Academy of Sciences*, 1162: 265–283.

Tallis, H.T., Ricketts, T., Nelson, E., Ennaanay, D., Wolny, S., Olwero, N., Vigerstol, K., Pennington, D., Mendoza, G., Aukema, J., Foster, J., Forrest, J., Cameron, D., Arkema, K., Lonsdorf, E. & Kennedy, C. 2010. *InVEST 1.004 beta user's guide*. The Natural Capital Project, Stanford University.

TEEB. 2009. *The economics of ecosystems and biodiversity for national and international policy makers – Summary: Responding to the value of nature 2009*.

Tilman, D. 1996. Biodiversity: Population versus ecosystem stability. *Ecology*, 77: 350–363.

Troy, M. & Wilson, M.A. 2006. Mapping ecosystem services: Practical challenges and opportunities in linking GIS and value transfer. *Ecological Economics*, 60: 435–449.

Vatn, A. 2000. The environment as a commodity. *Environmental Values*, 9: 493–509.

Walker, S., Brower, A.L., Stephens, R.T.T. & Lee, W.G. 2009. Why bartering biodiversity fails. *Conservation Letters*, 2: 149–157.

Wallace, K.J. 2007. Classification of ecosystem services: Problems and solutions. *Conservation Biology*, 139: 235–246.

Wang, L., Lyons, J., Kanehl, P. & Gatti, R. 1997. Influences of watershed land use on habitat quality and biotic integrity in Wisconsin streams. *Fisheries*, 22: 6–12.

Wendland, K.J., Honzak, M., Portela, R., Vitale, B., Rubinoff, S. & Randrianarisoa, J. 2010. Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar. *Ecological Economics*, 69(11): 2093–2107.

Worm, B., Barbier, E.B., Beaumont, N., Duffy, J.E., Folke, C., Halpern, B.S., Jackson, J.B.C., Lotze, H.K., Micheli, F., Palumbi, S.R., Sala, E., Selkoe, K.A., Stachowicz, J.J. & Watson, R. 2006. Impacts of biodiversity loss on ocean ecosystem services. *Science*, 314: 787–790.

Wunder, S., Campbell, B., Frost, P.G.H., Sayer, J.A., Iwan, R. & Wollenberg, L. 2008. When donors get cold feet: The community conservation concession in Setulang (Kalimantan, Indonesia) that never happened. *Ecology and Society*, 13(1): 12 (available at http://www.ecologyandsociety.org/vol13/iss1/art12/).

Wunscher, T., Engel, S. & Wunder, S. 2006. Payments for environmental services in Costa Rica: Increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture*, 45(4): 317–335.

GROWING BIODIVERSITY BANKING

***Sarah A. Bekessy*[1], *Brendan A. Wintle*[2], *David B. Lindenmayer*[3], *Michael A. Mccarthy*[2], *Mark Colyvan*[4], *Mark A. Burgman*[2] and *Hugh P. Possingham*[5]**

[1]School of Global Studies, Social Science and Planning, RMIT University, Melbourne, Australia
[2]School of Botany, The University of Melbourne, Melbourne, Australia
[3]Fenner School of Environment and Society, Australian National University, Canberra, Australia
[4]School of Philosophical and Historical Inquiry, University of Sydney, Sydney, Australia
[5]The Ecology Centre, The University of Queensland, St. Lucia, Australia

© FAO/M. Marzot


© S. Schlingloff

Biodiversity banking and vegetation offset schemes are now applied in countries around the world in an attempt to halt ongoing vegetation loss in already heavily altered landscapes (Fox and Nino-Murcia, 2005). Under these schemes, proponents of a development involving clearance or alteration to vegetation are required to provide an offset of an equivalent or better biodiversity value, evaluated using a biodiversity value metric. However, offsetting vegetation destruction to mitigate environmental damage will unquestionably result in further loss of biodiversity unless a more rigorous scientific approach is adopted (Bekessy *et al.*, 2010).

ALLOWING THE PROTECTION OF EXISTING ASSETS AS AN OFFSET WILL DEPLETE BIODIVERSITY

Many biodiversity banking schemes allow vegetation clearance to be offset by the protection of existing vegetation through changes in tenure or security arrangements, rather than requiring revegetation of cleared areas. This will result in a net loss of habitat. In the best-case scenario, when the offset site is protected in perpetuity and managed so that its condition improves over time, there is still a net loss of habitat. However, many biodiversity banking schemes include ambiguous responsibilities for ongoing protection and management of offsets, which many lead to even greater losses of habitat in the landscape.

UNCERTAINTY PRECLUDES THE PROMISE OF FUTURE REVEGETATED HABITAT AS A NET-GAIN OPTION

The uncertainties surrounding revegetation success are very high (Hynes *et al.*, 2004) and multipliers to account for uncertainties are likely to be unworkably large (Moilanen *et al.*, 2008). Furthermore, time lags in the availability of habitat may result in populations dropping below a minimum viable population size (Shaffer, 1981).

The unacceptably high level of risk to the environment of trading immediate loss of existing habitat against uncertain future gains through revegetation means that the value of offsets should be realised before assets are liquidated.

THE BIODIVERSITY BANK AS A SAVINGS BANK

It is proposed that for biodiversity banking to provide genuine net-gain outcomes, biodiversity assets must be banked for the future and trading allowed only once it can be demonstrated that assets have matured (Bekessy *et al.*, 2010). The value of 'saved' biodiversity assets should be demonstrated before they can be made available to offset loss of vegetation elsewhere. Mature vegetation could be sold to a party interested in clearing an equivalent amount and quality of vegetation. Alternatively, a market could be established for buying and selling banked biodiversity (i.e. habitat created above and beyond 'duty of care'). A few other considerations include:

- The currency of trade must reflect ecological realities, including irreplaceability (Pressey *et al.*, 1994) and the dynamic nature of landscapes;
- Responsibility for maintaining and protecting offsets must be identified;
- Implementation must be closely regulated and legally enforceable (Bekessy *et al.*, 2010).

USING CARBON INVESTMENT TO GROW THE BIODIVERSITY BANK

If correctly harnessed, the power of carbon initiatives could fuel the biodiversity savings bank (Bekessy and Wintle, 2008). An important step will be to allow investors to simultaneously accrue carbon and biodiversity credits from the one parcel of land.


© FAO/J. Burgess

Previous page:

↖ Replacing old-growth forests with plantations negatively affects ecosystem services, especially carbon sequestration and biodiversity.

Current pages (from left to right):

→ Deforested slopes can create a disruption in water and soil ecosystem service delivery.

→ While offsets can include the rehabilitation of logged forests, ecological restoration is often very long and difficult, so conservation should be the priority.

→ Land management practices can impact carbon emissions, so changes in emission regimes can be also sold as an offset.

CONCLUSION

Biobanking may have appeal as an elegant economic instrument for balancing economic growth with biodiversity conservation. However, the purpose is dubious if it fails to deliver real benefits for biodiversity and may, in effect, reduce pressure on developers to avoid harm. The extinction debt in many parts of the world from past clearance means that we need vegetation policies that aim to achieve net gain in the landscape. The only way to achieve this through offsetting schemes is if the biodiversity bank is established as a genuine savings bank.

REFERENCES

Bekessy, S.A. & Wintle, B.A. 2008. Using carbon investment to grow the biodiversity bank. *Conservation Biology*, 22(3): 510–513.

Bekessy, S.A., Wintle, B.A., Lindenmayer, D.B., McCarthy, M.A., Colyvan, M., Burgman, M.A. & Possingham, H.P. 2010. The biodiversity bank cannot be a lending bank. *Conservation Letters*, 3: 151–158.

Fox, J. & Nino-Murcia, A. 2005. Status of species conservation banking in the United States. *Conservation Biology*, 19: 996–1007.

Hynes, L.N., McDonnell, M.J. & Williams, N.S.G. 2004. Measuring the success of urban riparian revegetation projects using remnant vegetation as a reference community. *Ecological Management and Restoration*, 5: 205–209.

Moilanen, A., van Teeffelen, A.J., Ben-Haim, Y. & Ferrier, S. 2008. How much compensation is enough? A framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat. *Restoration Ecology*, 17: 470–478.

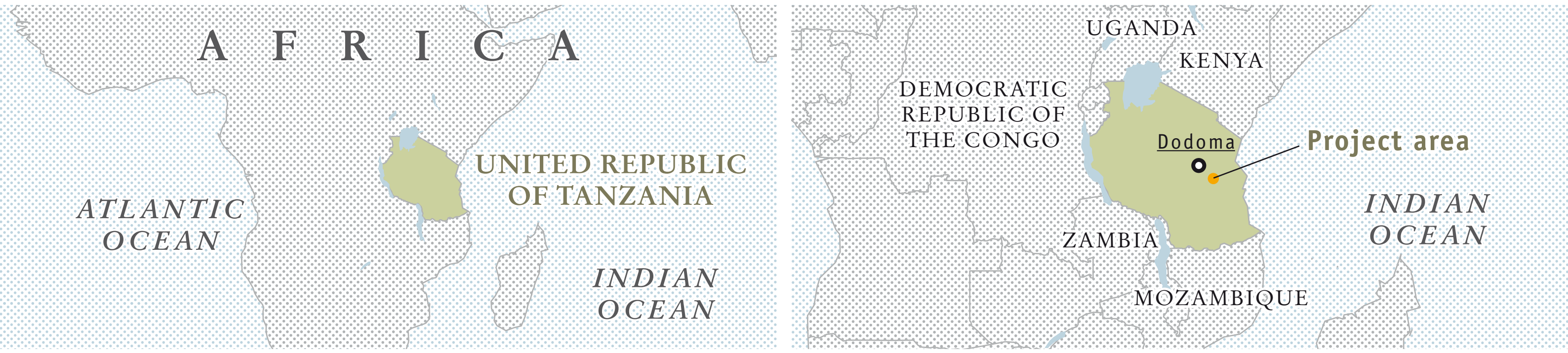
Pressey, R.L., Johnson, I.R. & Wilson, P.D. 1994. Shades of irreplaceability: Towards a measure of the contribution of sites to a reservation goal. *Biodiversity Conservation*, 3: 242–262.

Shaffer, M.L. 1981. Minimum population sizes for species conservation. *BioScience*, 31: 131–134.

PES IN THE RUVU WATERSHED OF THE ULUGURU MOUNTAINS, TANZANIA

Dosteus Lopa[1] *and Rohit Jindal*[2]
[1]CARE International, Dar-es-Salaam, Tanzania
[2]Michigan State University, East Lansing, Minnesota, USA

© V. Meadu



The Uluguru Mountains are a range in eastern Tanzania that blocks the moisture coming from the Indian Ocean. Consequently, they are characterised by wet slopes, where the overall annual precipitation on the east-facing slopes exceeds 2 000 mm. Rainfall is captured in a complex network of streams that join to form the Ruvu River, which supplies water to over four million people in Dar-es-Salaam and to the major industries of Tanzania. About 150 000 people live in the Uluguru Mountains in about 50 villages situated on the edge of the forested areas.

In 2007, a hydrological assessment by CARE-WWF revealed an overall decrease of water quality with an average increase of five NTUs (Nephelometric Turbidity Units) per year, indicating a dramatic increase in sediment loading into the river. At the same time, significant fluctuations have been recorded in the annual volume flow of the Ruvu River due to variations in the precipitation regime, as well as to the runoff and overall decrease of the storage capacity of the river's tributaries. As a consequence, downstream water treatments are needed due to high level of siltation of the Ruvu River and often downstream water supply needs to be rationed. The restoration of the Ruvu's hydrologic services is mainly linked to improved upstream land-use management, which is strictly linked to poverty alleviation and livelihood improvements of the people inhabiting this region with a very high population density.

Thirty-one percent of the population of the Uluguru live on less than one dollar (USD) per day, with subsistence farming of very small agricultural plots that are managed with slash-and-burn practices. Land fragmentation is extremely high and aggravates food security. According to the CARE-WWF investigation (2007), 86 percent of the farmers in Kibungo-Juu own no more than two hectares of land. Productivity of such small agricultural plots is very low due to low soil fertility (e.g. on average, about 200 kg of maize per acre) and financial constraints in implementing practices to counteract the continuous loss of soil and nutrients by erosion and runoff.

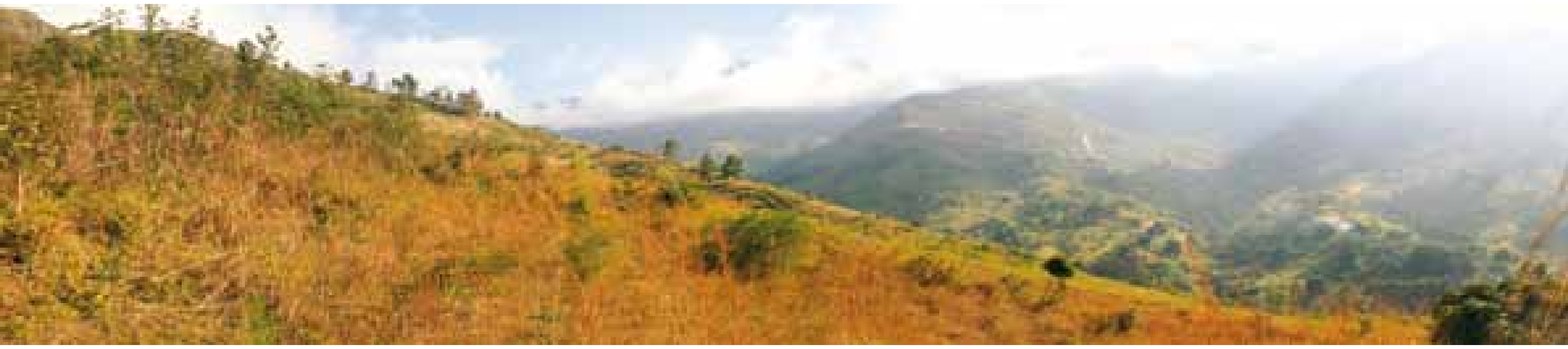
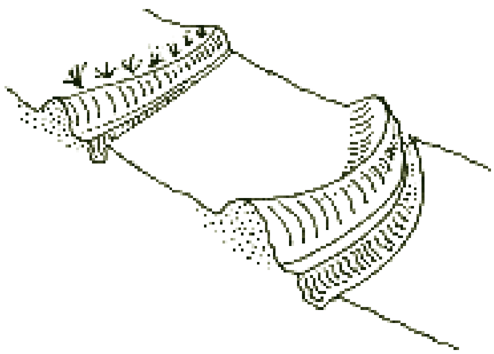
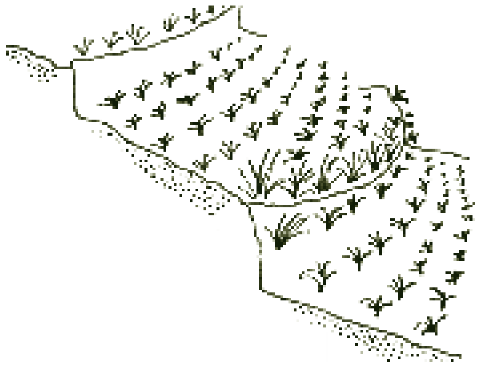


Figure 9
Newly established traditional terrace (*fanya juu*)



Source: IIRR, 2008

Figure 10
Traditional terrace (*fanya juu*) after 5 years



Source: IIRR, 2008

In the subcatchment of the Mfizigo River, a joint CARE-WWF Programme (2006-2011) promoted a PES scheme between the downstream buyers (the industrial Water Supply and Sewerage Corporation [DAWASCO] and Coca Cola Kwanza Ltd.) and the upstream sellers (currently about 265 farmers are engaged) from the Lukenge, Kibungo, Lanzi, Dimilo and Nyingwa villages (Figure 11).

Farmers received payment for the adoption of agriculture practices aimed at controlling runoff and soil erosion, while improving their crop production. A combined approach is being implemented that includes structural (bench terraces and *fanya* terraces) (Figure 9 and 10), vegetative (reforestation, agroforestry and grass strips) and agronomic measures (intercropping crops with fruit trees, mulching and fertilising with animal manure) to limit runoff, combat soil erosion, and increase soil moisture and productivity.

© M. Mahdi Karim

Figure 11

Location of the area of PES scheme implementation and locations of the two main companies paying for increased water quality and quantity of the Ruvu River

LEGEND

Areas involved in PES schemes — Water intake — Water pipe

Adapted from original map by Heri Kayeyey Masudi (Sokoine University of Agriculture)

Payments are allocated according to how many hectares of land are converted and the type of agricultural and/or land-use practice adopted. The estimated costs of the adoption of these practices (Table 5) were evaluated by CARE-WWF upon consultation with discussion groups and village assemblies and an evaluation of economic returns provided by maize, beans, cassava, rice and bananas, the most common crops in the Uluguru area (Lopa, 2010).

An auction carried out by PRESA in the Kinole area and sub-catchment of the Mbezi River (March 2009) also provided additional information on the estimated opportunity costs related to reforestation activities. The auction involved over 300 participants belonging to ten different

Table 5

Opportunity costs and payments received by farmers for soil erosion control practices

Structural and vegetative agronomic practice to control runoff and soil erosion	% of land that will not be cultivated due to the adoption of a particular agronomic practice	First year opportunity cost (Tsh./ha)	First year labour cost (Tsh./ha)	First year total cost (Tsh./ha)
Bench terraces	100%	160 000	210 000	370 000
Reforestation	100%	160 000	75 000	235 000
Riparian restoration	100%	160 000	12 000	172 000
Fanya juu	20%	32 000	155 610	187 610
Agroforestry	17%	27 200	13 500	40 700
Grass stripping	17%	27 200	13 500	40 700
Pineapple contour farming	14%	22 400	18 000	40 400

Tsh. = Tanzanian shillings
Source: CARE-WWF, 2008

settlements and revealed the costs perceived by the farmers for changing their land use from seasonal cropping to woodlots using different types of autochthonous trees. The mean estimated cost of planting 400 trees over one hectare (at a spacing of 5x5 m) and for protecting trees for at least three years was of about Tsh. 240 000. During these three years, farmers were responsible for looking after their trees, although they were free to grow crops between the trees. In a first bidding round, the cost of planting 40 *Khaya anthoteca* trees (an indigenous timber species) and 40 *Tectona grandis* trees (teak, a slow growing tree that is popular among local farmers for its valuable timber) was estimated, while in a second bidding round, a mix of species of 40 *Khaya anthoteca* trees and 40 *Faidherbia albida* trees (an indigenous tree that can grow among field crops as it sheds its leaves during the rainy season and provides firewood


© H. Liniger / WOCAT

Previous pages:

↖ The Uluguru Mountains in eastern Tanzania are characterised by an extremely variable vegetation ranging from coastal to montane and upper montane forest types.

Current pages (from left to right):

→ Stakeholder consultation with a local community in the Uluguru Mountains led by representatives of CARE and the World Agroforestry Centre.

→ Traditional agricultural landscape with the fanya juu terracing system supports soil conservation.

→ The devastating effects of soil loss from runoff on degraded land.

and traditional medicine). Despite the species mix used, the opportunity costs of these two bidding rounds were very similar (Jindal, 2010).

The case study of PES in the Uluguru Mountains shows how estimating the opportunity costs is a key factor in the design of PES schemes to ensure farmers participation. Long-term involvement of farmers is also necessary to meet the time scale requirements to restore the functionality of ecosystem processes.

REFERENCES

CARE-WWF. 2007. *Hydrologic and land use/cover change analysis for the Ruvu River (Uluguru) and Sigi River (East Usambara) watersheds*. EPWS Phase I-Making the Business Case. Dar-es-Salaam, CARE International and World Wildlife Fund.

CARE-WWF. 2008. *Summary contract price for soil conservation technologies chosen by the project team in November 2008*. Dar-es-Salaam, CARE International and World Wildlife Fund.

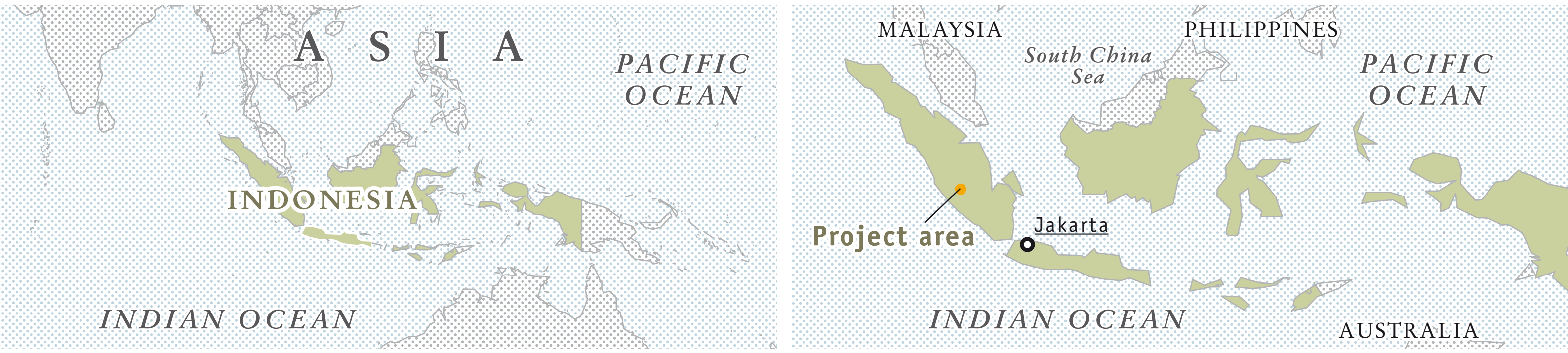
International Institute of Rural Reconstruction (IIRR). 2008. (available at http://www.infonet-biovision.org/print/ct/265/soilManagement).

Jindal, R. 2010. *Estimating 'payment' in payments for environmental services: Results from field auctions in the Uluguru Mountains, Tanzania*. Paper presented at the Heartland Environmental Economics Workshop, 17–18 October 2010, University of Illinois, USA.

Lopa, D. 2010. *Equitable payments for watershed services*. Poster presented at the FAO stakeholders consultation on Food Security through Additional Income: From PES to the Remuneration of Positive Externalities in the Agricultural and Food Sector, 27–28 September 2010, Rome, Italy.

RUBBER AGROFORESTRY AND PES FOR PRESERVATION OF BIODIVERSITY IN BUNGO DISTRICT, SUMATRA

Laxman Joshi[1], *Rachman Pasha*[2], *Elok Mulyoutami*[2] *and Hendrien Beukema*[3]
[1]International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
[2]World Agroforestry Centre (ICRAF), Nairobi, Kenya
[3]University of Groningen, Groningen, The Netherlands

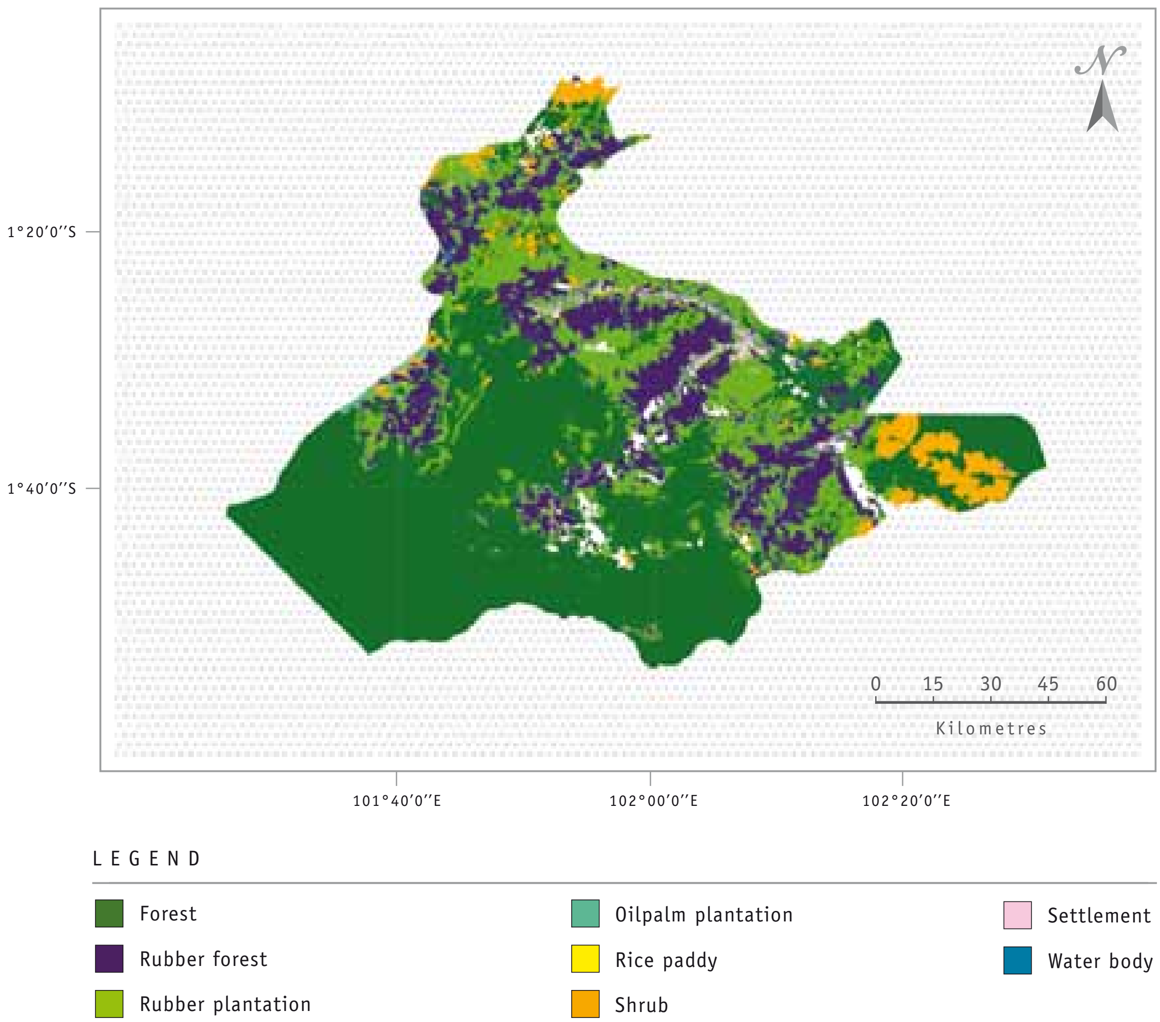


The introduction of the rubber tree (*Hevea brasiliensis*), naturally found in the floodplains forests along the Amazon River, began in Indonesia in the second half of the 19th century. In Sumatra and Borneo, rubber cultivation, initially restricted along rivers with good accessibility, rapidly spread to even relatively remote areas in the country. Currently, Indonesia is the world's second largest gum exporter with an overall rubber area of 3.5 million hectares. More than one million households depend on rubber-generating income in Indonesia, as 83 percent of the rubber cultivation area is constituted by smallholder rubber agroforestry systems (Wibawa *et al.*, 2005).

Bungo district, located in the western area of the Jambi Province, the third most important Indonesian province for rubber production, is surrounded by three national parks: Kerinci Seblat, Bukit Dua Belas and Bukit Tiga Puluh. The district has been severely deforested (60 percent forest loss) and forests have been replaced by rubber and oil palm plantations, as well as other agricultural land uses. In particular, from the late 1980s, an increased spread in oil plantation cultivation has led to the additional loss of native trees and simplification of the agro-ecological landscape (Fentreine *et al.*, 2010). A remote sensing study showed that in 1998 the remaining forests, mostly located on the Barisan range, covered only 28 percent of Bungo district, while in the area occupied by jungle rubber has decreased from 17 percent (1988) to 11 percent (2008) due to a parallel increase in monoculture covering from 23 percent (1988) to 49 percent (2008) of the district area (Ekadinata *et al.*, 2010) (Figure 12 and 13).

In Bungo district, rubber is cultivated in monoculture systems, as well as in more complex rubber agroforestry systems. A rubber agroforest usually starts from slashing a forest plot (either primary or secondary forest) or an old rubber garden, followed by burning the felled trees during the dry season. For the first one to two years, rubber seedlings are grown with rice and other annual crops. When the rubber trees begin to shade annual crops, the plots are left 'fallow' and the native vegetation regenerates. Non-rubber trees are regularly removed or kept below the level of rubber trees and periodic weeding is done around the rubber saplings. The rubber trees reach maturity in seven to ten years, at which time the farmers begin tapping (Joshi *et al.*,

Figure 12
Land cover of Bungo district in 1988



Adapted from original map by Andree Ekadinata (ICRAF)

Current pages (from left to right):

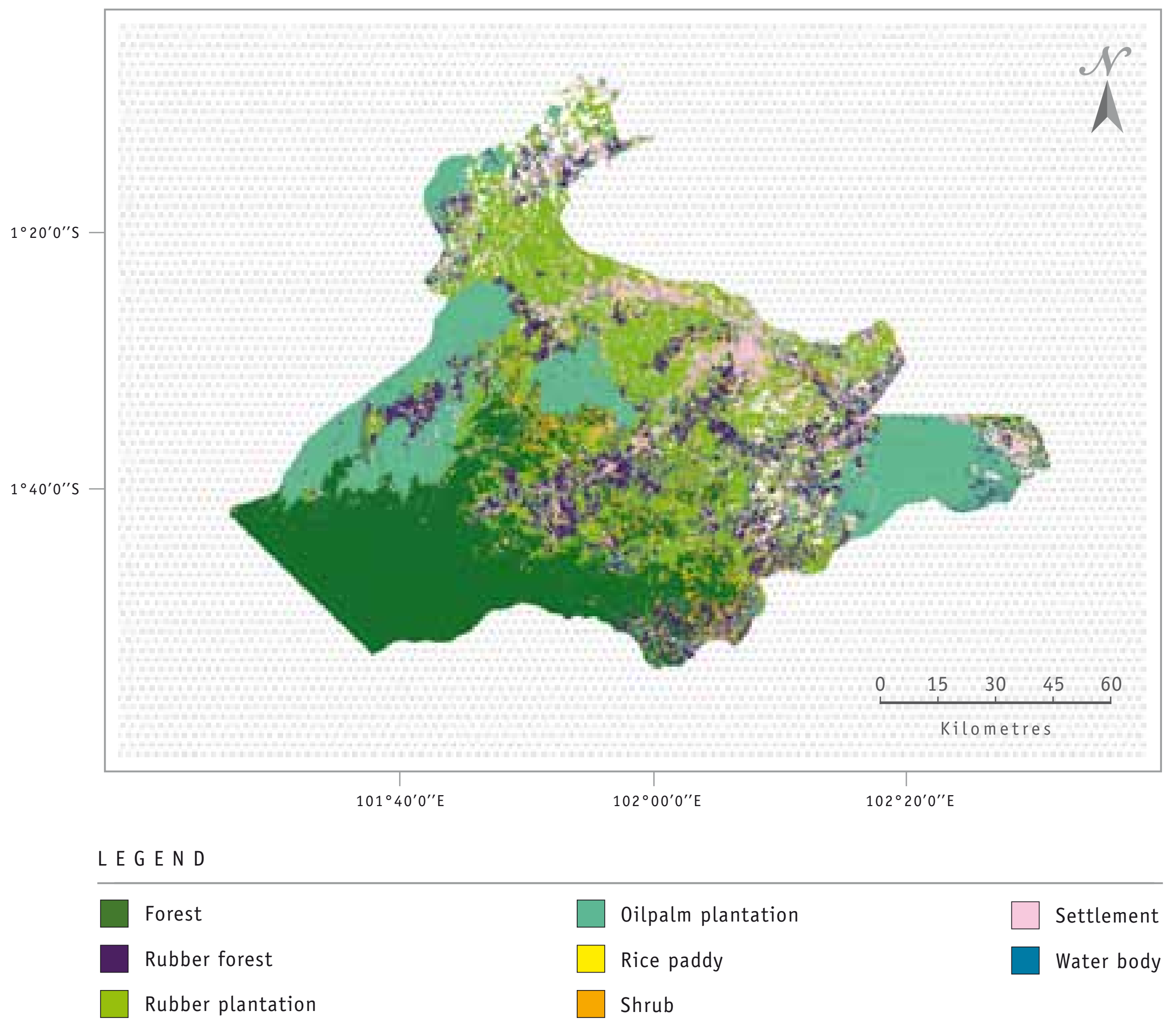
→Surroundings of Lubuk Beringin, the first village granted with the legal right (*hutan desa*) by the Indonesian Government to manage state forests for their own prosperity.

→View of the forested area designated for community forestry permits, which could help meet forest management targets and livelihood interests of local villages.

→Rubber jungle, a traditional agroforestry practice that mixes jungle plants among rubber trees.

→Example of jungle rubber bordering a rice paddy.

Figure 13
Land cover of Bungo district in 2008



Adapted from original map by Andree Ekadinata (ICRAF)

2003; Wibawa *et al.*, 2005). These traditional rubber gardens are complex in structure. Gradually over time rubber trees die due to natural causes and other native species begin to become more dominant. The latex productivity in these gardens, thus, gradually declines. About 25-40 years after planting, when tapping is no longer economical, all the trees are felled and the plot is cleared for replanting. However, some farmers plant rubber seedlings in the gaps caused by the death of rubber and non-rubber trees; this gap-planting, locally known as *sisipan*, leads to unevenly aged rubber trees when carried out over multiple years. The rubber productivity period can be prolonged using the *sisipan* technique, but the *sisipan* plots are never as productive as normal rubber gardens. Compared to slash-and-burn, however, the *sisipan* practice is less labour intensive and does not require much capital investment. It also allows a reduced but continuous income from the plot (Joshi *et al.*, 2002; Wibawa *et al.*, 2005); hence, it is practised mostly by poor farmers in less accessible areas. The biodiversity inside such *sisipan* plots is normally very high, comparable to surrounding forests both in structure and function as large trees and naturally regenerating vegetation is retained in the plots. These plots become 'very complex rubber agroforests' that are often referred to as 'jungle rubber'.

In 2004, ICRAF initiated a PES pilot project in Bungo district (Jambi province) to develop a reward mechanism in order to conserve the rich biodiversity inside the complex rubber agroforests.

In general terms, quantifying biodiversity in jungle rubber is methodologically quite challenging as the potential occurrence of many confounding variables and the high variability found amongst jungle rubber gardens would require a large number of sampling units. In fact, in the Jambi region, rubber cultivation is composed of a mosaic of small jungle rubber gardens at different development stages, rubber densities and management practices. Potential factors that influence the species number (α diversity) and the rate of change in species composition (β diversity) are the plot size, the history and management of the plot and the surrounding landscape, the geographic location of the jungle rubber garden, the elevation, and the adjacency to forest remnants, to other rubber jungles or the influence of an agricultural matrix (Beukema *et al.*,

Current pages (from left to right):

→The economic boom in palm oil since the 1980s has seen millions of hectares of community forests in Sumatra converted into oil palm plantations.

→Oil palm is much more profitable for smallholders than rice production and is highly competitive with rubber.

→In Bungo, rubber cultivation is done in a mosaic of small rubber jungle plots interspersed with other crop fields, such as rice paddies.

→Rice paddies near Lubuk Beringin village are an important livelihood source for villagers in Bungo.

2007; Wibawa *et al.*, 2005). In addition, extensive biodiversity surveys in tropical ecosystems are very challenging due to the high density of species (e.g. 100 vascular plant species in 0.02 ha of jungle rubber) and the difficult and time-consuming task of species identification (Gillison *et al.,* 2000*b*).

A study of the available published and unpublished investigations conducted in the 1990s on €and β diversity recorded in primary forest, jungle rubber and rubber monoculture plantations revealed that jungle rubber had a much lower number of epiphytic pteridophyte and tree species, a similar number of bird species, and a higher number of terrestrial pteridophyte species than primary forest (Beukema *et al.*, 2007). The lower number of epiphytic pteridophyte species may be due to the fact that many epiphytes depend on later successional stages of forest and may not have had enough time to establish and reproduce. Thus, for some species, even a 40-year-old jungle rubber garden might be too young to serve as a suitable habitat.

The lower richness of tree species recorded in jungle rubber (Figure 14) may also be explained by the fact that jungle rubber is a type of secondary forest, where late-successional tree species may not have established yet. Selective species removal by the farmer is another important factor.

Although the total number of bird species in jungle rubber and primary forest (Figure 15) was similar, the number of forest-specialist birds was much lower in jungle rubber.

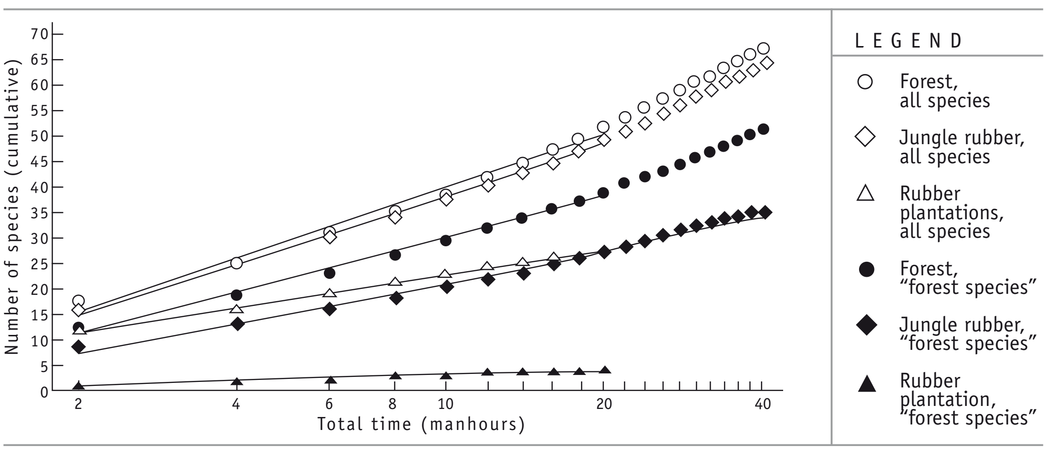
The same was true for terrestrial pteridophytes (Figure 16): for a subset of forest species, the number of species found was much lower in jungle rubber than in primary forest (Beukema *et al*. 2007).

RUPES also carried out rapid biodiversity assessments in Bungo district and found that of a total of 971 tree species recorded inside jungle rubber gardens (77 analysed plots), 376 tree species were found both in jungle rubber gardens and natural forest patches (31 analysed plots). Complex rubber agroforests also harbour a fair number of mammals species (n=37) compared to the number found in the surrounding national parks (n=85). Of these 37 mammals species, nine are endangered species under CITES criteria (ICRAF, n.d.).

Figure 14

Species-accumulation curves for individual trees of DBH over 10 cm, for 3.2 ha of primary forest (Laumonier, 1997, dots) and 3.2 ha of jungle rubber (Hardiwinoto *et al.*, 1999; diamonds).

Open diamonds: all trees including rubber trees. Filled diamonds: rubber trees excluded from the jungle rubber data.



Adapted from Figure 6 in Beukema *et al.*, 2007: 227

The biodiversity assessments indicated that complex rubber agroforests in Bungo not only represents secondary habitats/refuges for forest species, but they are also important connectors amongst remaining fragmented forest patches. According to the landscape configuration, complex rubber agroforests can constitute a series of stepping stones or more continuous corridors (van Noordwijk, 2005).

At the community level, the RUPES project initiated a number of activities aimed to assess the strengths, weaknesses, threats and opportunities of traditional rubber cultivation that can maintain rich biodiversity. Local perception and needs were assessed through consultations and research. Activities to enhance the awareness of the local communities about the value of their traditional system for biodiversity conservation were implemented. Communities of Letung, Sangi, Mengkuang Besar, Mengkuang Kecil and Lubuk Beringin villages agreed to retain their complex

Current pages (from left to right):

→ Natural rubber comes from the milky latex found in the bark of rubber trees.

→ Tapping involves extracting latex from a rubber tree by shearing off a thin layer of bark in downward half spiral on the tree trunk.

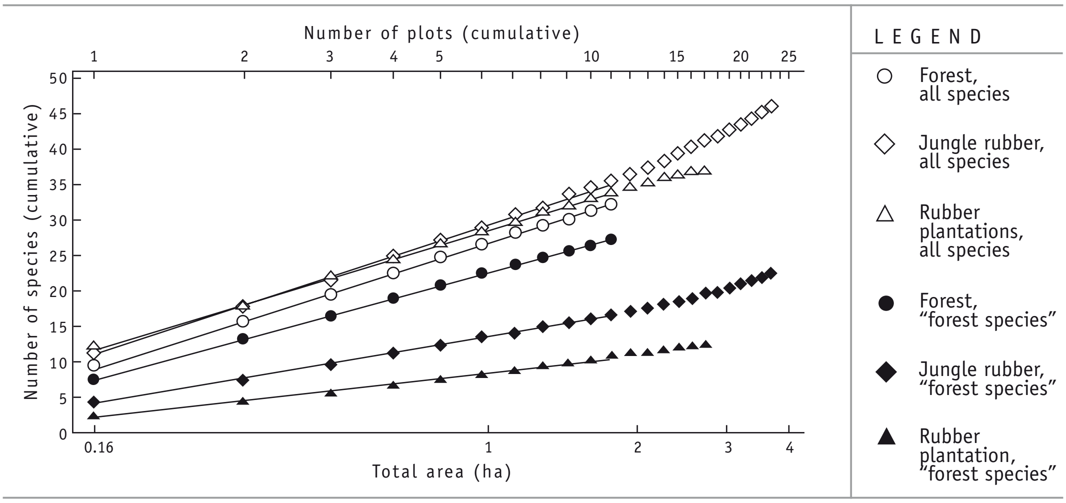
→ Rubber slab containing a high percentage (about 45 percent) of dry rubber content.

→ Micro-hydropower as non-financial reward for Lubuk Beringin village for conserving biodiverse jungle rubber systems.

Figure 15

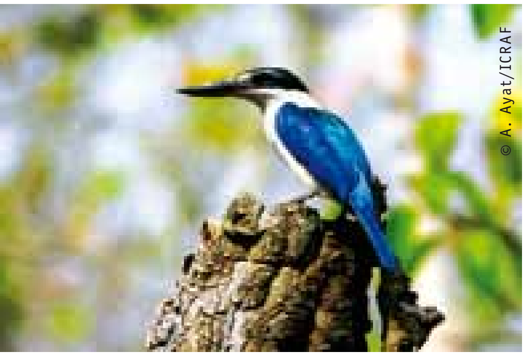
Species-accumulation curves for the bird data of Danielsen and Heegaard, 1995.

Open symbols: all birds identified to species level. Filled symbols: subset of 'forest species' classified in habitat group 1: species mostly associated with the primary and old secondary forest interior.



Adapted from Figure 8 in Beukema *et al.*, 2007: 228

rubber agroforests (total of about 2 500 ha) if incentives are provided. The incentives local people requested include support to establish micro-hydro power plants, setting up of rubber nurseries and demonstration plots of improved rubber agroforests, and clonal plants of high yielding rubber trees for intensively managed rubber gardens elsewhere. Conservation agreements were signed by these four villages in 2006 (ICRAF, n.d.; Leimona and Joshi, 2010). The incentives provided then were seen only as an interim reward while a more permanent reward mechanism is being sought. RUPES is currently considering an eco-certification scheme for these complex rubber agroforests that will fetch a price premium for the natural rubber from the 'jungle' to be used in niche markets, such as 'green cars' and bicycle tyres. There is also a possibility of bundling biodiversity services together with other services, such as carbon or water quality (Leimona and Joshi, 2010).



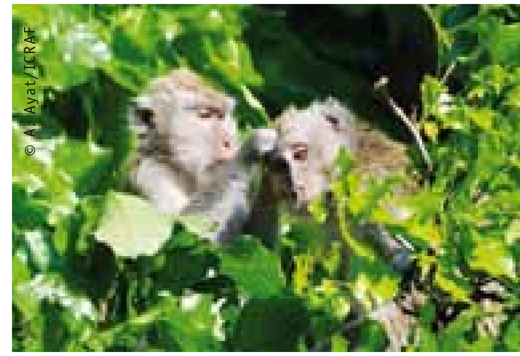
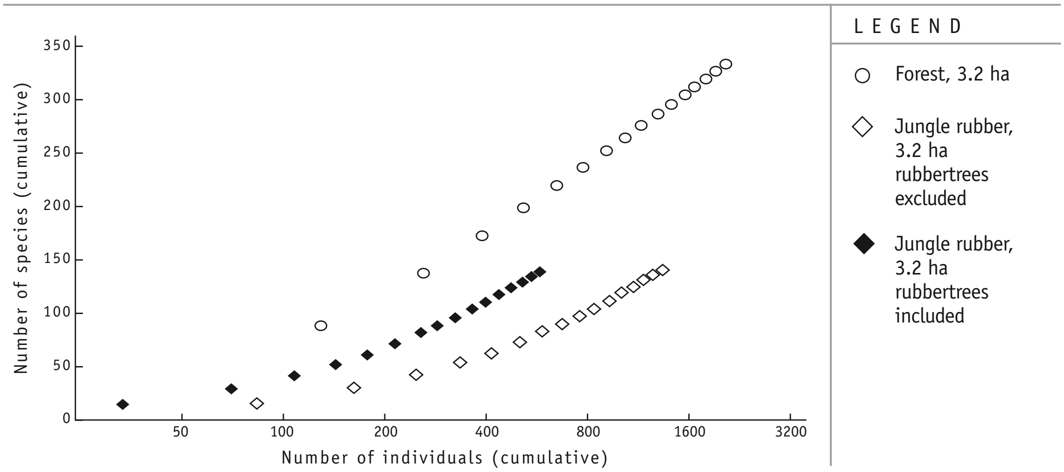


Figure 16

Species-accumulation curves for terrestrial pteridophytes in forests (dots), jungle rubber (diamonds) and rubber plantations (triangles).

Open symbols: all terrestrial pteridophyte species; filled symbols: 'forest species' subset. Plots were 0.16 ha each, non-adjacent and spread over a large area in Jambi province.



Adapted from Figure 7 in Beukema *et al.*, 2007: 228

The Bungo case study is a clear example on how biodiversity assessments are comprised of multiple layers of information. In this case, the generic relationship between rubber agroforestry and biodiversity has to be decomposed in at least four different levels, distinguishing between (a) plant and (b) animal levels of biodiversity, while considering biodiversity conservation at both the (c) plot and (d) landscape levels. Moreover, jungle rubber gardens also show the crucial relationship between biodiversity and land management over time because not only different management regimes influenced the recorded biodiversity level, but under the same management regime jungle rubber gardens of different ages host different levels of biodiversity.

Examples of animal biodiversity found in the forest and forest-edge habitat of Bungo district, where jungle rubber gardens often constitute a corridor between remaining forest patches (from left to right):

→ Collared kingfisher (*Halcyon chloris*).
→ Painted bronzeback snake (*Dendrelaphis pictus*).
→ Crab-eating macaque (*Macaca fascicularis*).
→ Indian momtjac (*Muntiacus muntiak*).

REFERENCES

Beukema, H., Danielsen, F., Vincent, G., Hardiwinoto, S. & van Andel, J. 2007. Plant and bird diversity in rubber agroforests in the lowlands of Sumatra, Indonesia. *Agroforestry Systems*, 70: 217–242.

Danielsen, F. & Heegaard, M. 1995. Impact of logging and plantation development on species diversity—a case study from Sumatra. *In* Ø. Sandbukt, ed. *Management of tropical forests: Towards an integrated perspective*, pp. 73–92. Oslo, Centre for Development and the Environment, University of Oslo.

Ekadinata, A., Zulkarnaen, M.T. & Widayati, A. 2010. Agroforestry area under threats: Dynamics and trajectories of rubber agroforest in Bungo district, Jambi. *In* B. Leimona & L. Joshi, eds. *Eco-certified natural rubber from sustainable rubber agroforestry in Sumatra, Indonesia – Final Report*. Bogor, World Agroforestry Centre (ICRAF)-Southeast Asia Regional Office.

Ekadinata, A. & Vincent, G. In press. Rubber agroforest in a changing landscape: Analysis of land use/cover trajectories in Bungo district, Indonesia. *Forest, Trees and Livelihoods*.

Feintrenie, L., Ching, W.K. & Levang, P. 2010. Why do farmers prefer oil palm? Lessons learnt from Bungo district, Indonesia. *Small-scale Forestry*, 9: 379–396.

Gillison, A.N. 2000. *Above ground biodiversity assessment working group summary report 1996–99: Impact of different land uses on biodiversity and social indicators*. Nairobi, ASB Working Group Report, World Agroforestry Centre (ICRAF) (available at http://www.asb.cgiar.org/PDFwebdocs/ASB Biodiversity Report.pdf).

Hardiwinoto, S., Adriyanti, D.T., Suwarno, H.B., Aris, D., Wahyudi, M. & Sambas, S.M. 1999. *Draft report of the research: Stand structure and species composition of rubber agroforests in tropical ecosystems of Jambi, Sumatra*. Yogyakarta, Faculty of Forestry, Gadjah Mada University and Bogor, World Agroforestry Centre (ICRAF)-Southeast Asia Regional Office.

ICRAF. n.d. *Site profile: RUPES Bungo*. Bogor, World Agroforestry Centre (ICRAF) (available at http://www.worldagroforestry.org/sea/networks/rupes/download/SiteProfiles/RUPES-Bungo_FINAL.pdf).

Joshi, L., **Wibawa, G., Vincent, G., Boutin, D., Akiefnawati, R., Manurung, G., van Noordwijk, M. & Williams, S.E**. 2002. *Jungle rubber: A traditional agroforestry system under pressure*. Bogor, World Agroforestry Centre (ICRAF)-Southeast Asia Regional Office.

Joshi, L., **Wibawa, G., Beukema, H., Williams, S. & van Noordwijk, M.** 2003. Technological change and biodiversity in the rubber agroecosystem of Sumatra. *In* J. Vandermeer, ed. *Tropical Agroecosystems*, pp. 133–157. Florida, CRC Press.

Laumonier, Y. 1997. *The vegetation and physiography of Sumatra. Geobotany 22*. Dordrecht, Kluwer.

Leimona, B. & Joshi, L. 2010. *Eco-certified natural rubber from sustainable rubber agroforestry in Sumatra, Indonesia*. Project Final Report. Bogor, World Agroforestry Centre (ICRAF).

Rasnovi, S. 2006. *Ekologi regenerasi tumbuhan berkayu pada sistem agroforest karet (Regeneration ecology of woody trees in rubber agroforest systems)*. Sekolah Pasca Sarjana, Institut Pertanian Bogor, Bogor. (Doctoral dissertation).

van Noordwijk, M. 2005. *Rupes typology of environmental service worthy of reward*. Bogor, World Agroforestry Centre (ICRAF).

Wibawa, G., Hendratno, S. & van Noordwijk, M. 2005. Permanent smallholder rubber agroforestry systems in Sumatra, Indonesia. *In* Cheryl A. Palm, Stephen A. Vosti, Pedro A. Sanchez & Polly J. Ericksen, eds. *Slash-and-burn agriculture: The search for alternatives*. New York, Columbia University Press.

CHAPTER 4

COST-EFFECTIVE TARGETING OF PES

Katia Karousakis and Quiller Brooke
Organisation for Economic Co-operation and Development (OECD), Paris, France

Reproduced with permission from:
OECD, 2010. "Cost-effective targeting of payments for ecosystem services",
in Paying for Biodiversity: Enhancing the Cost-Effectiveness of Payments for Ecosystem Services,
OECD Publishing. Also available at http://dx.doi.org/10.1787/9789264090279-8-en

CONTENTS

ABSTRACT

Individuals or communities with the potential to influence the supply of ecosystem services will often differ in the magnitude of benefits they can provide, the risk that these services will otherwise be lost or the extent to which their management activities can enhance biodiversity and ecosystems, as well as the costs of service provision. This chapter discusses how PES programmes can be designed to address these issues and presents the tools and methods through which payments can be targeted to increase PES cost-effectiveness.

How payments for biodiversity and ecosystem services are targeted is critical in determining the cost-effectiveness of a PES programme. In most cases, the available budget for biodiversity and associated ecosystem services will be limited and competing with different demands. Cost-effective targeting of payments enables greater total benefits to be achieved with a given PES budget and can therefore also contribute to the long-term success of the programme.

Many PES programmes allocate uniform payments on a per hectare basis. This is cost effective if ecosystem service benefits and the costs of their provision are constant across space. In many cases however, this is unlikely. The more heterogeneous the costs and benefits are, the greater the cost-effectiveness gains that can be realized via targeted and differentiated payments. Indeed, more and more PES programmes are incorporating design elements to address this. This chapter examines the methods and tools that are available to target spatial heterogeneity in biodiversity and ecosystem service benefits, the threat of loss and the costs of their provision.

TARGETING ECOSYSTEM SERVICES WITH HIGH BENEFITS

Identifying areas with high biodiversity and ecosystem service benefits requires metrics and indicators to quantify them. Selecting an appropriate metric or indicator for PES that aims to enhance biodiversity conservation and sustainable use is not necessarily straightforward however. Unlike carbon, for example, which is measured in tonnes of carbon dioxide equivalents (tCO_2e), there is no single standardised metric to quantify biodiversity. The multidimensionality and the inherent complexity of biodiversity require trade-offs between the accuracy of a metric and the costs of development. The appropriate biodiversity metric or indicator selected for a PES programme may also depend on the specific objectives of the programme. Indeed, methodologies for constructing metrics and indicators tend to be tailored to specific local, regional and national programmes and their objectives. Examples of metrics and indicators used across two biodiversity PES programmes, namely the Victorian BushTender programme in Australia and the PES scheme implemented in the Assiniboine River watershed of east-central Saskatchewan province in Canada are presented in Box 1.

The inherent complexity of biodiversity requires trade-offs between measurement accuracy and the cost of biodiversity assessments

Box 1

Metrics and indicators used to target biodiversity benefits in the Victorian BushTender and a Canadian pilot PES

The Habitat Hectare methodology in the Victorian BushTender programme

The aim of Victorian BushTender programme in Australia is to improve the management of native vegetation on private land. To quantify biodiversity benefits, the BushTender programme uses the Habitat Hectare (HH) methodology. The HH is comprised of an assessment of the local benefits via the Biodiversity Benefits Index (BBI). The BBI is based on the proposed management practices; the conservation significance in terms of regional priorities through the Biodiversity Significance Score (BSS), the cost of conserving the land (*b*) and the size of the proposed land (ha). Potential plots are compared through an inverse auction, where landholders submit bids including information on the proposed area, the BBI and the required payment. The BSS is calculated separately to improve competition (DSE, 2009).

HH = BBI x ha

BBI = (BSS x HSS) *b*

where

HH = Habitat Hectare;

BBI = Biodiversity Benefits Index;

ha = area in hectares;

BSS = Biodiversity Significance Score;

HSS = Habitat Service Score; *b* = cost of bid

Targeting Waterfowl in a Canadian pilot PES programme

In Canada, a pilot PES programme initiated in 2008 to restore drained wetlands was undertaken in the Assiniboine River watershed of east-central Saskatchewan. The Environmental Benefits Index (EBI) was based on the incremental increase in predicted hatched waterfowl nests relative to the bid price. The EBI was based on the Ducks Unlimited Canada Waterfowl Productivity Model (DUC) which evaluated the potential of wetland restoration on each plot to increase the number of hatched waterfowl nests in the Assiniboine watershed. The EBI was based on wetland area restored, waterfowl density, existing wetland density and the percentage of cropland in a 4x4 mile block around the plot (Hill *et al.*, 2011).

The use of such metrics to better target ecosystem service payments can substantially enhance PES cost-effectiveness. In the Tasmanian Forest Conservation Fund programme, for example, a comparison of using the AUD/CVI[1] metric with a simpler AUD/ha[2] metric indicated an 18.6 percent gain in conservation outcomes. Comparing the additional conservation gains (valued at approximately AUD 3.3 million) with the costs of achieving those benefits (AUD 0.5 million), illustrate that the ratio of benefits to costs from investing in the CVI is 6.9:1. Similarly, Wunscher *et al.* (2006) simulated different targeting approaches for the Costa Rican PES and estimated that a scenario selecting highest scoring sites with the given budget would have resulted in 14 percent higher benefits than the current system of selecting sites (see Case Study 5 “PES in Costa Rica”).

SPATIAL MAPPING TOOLS

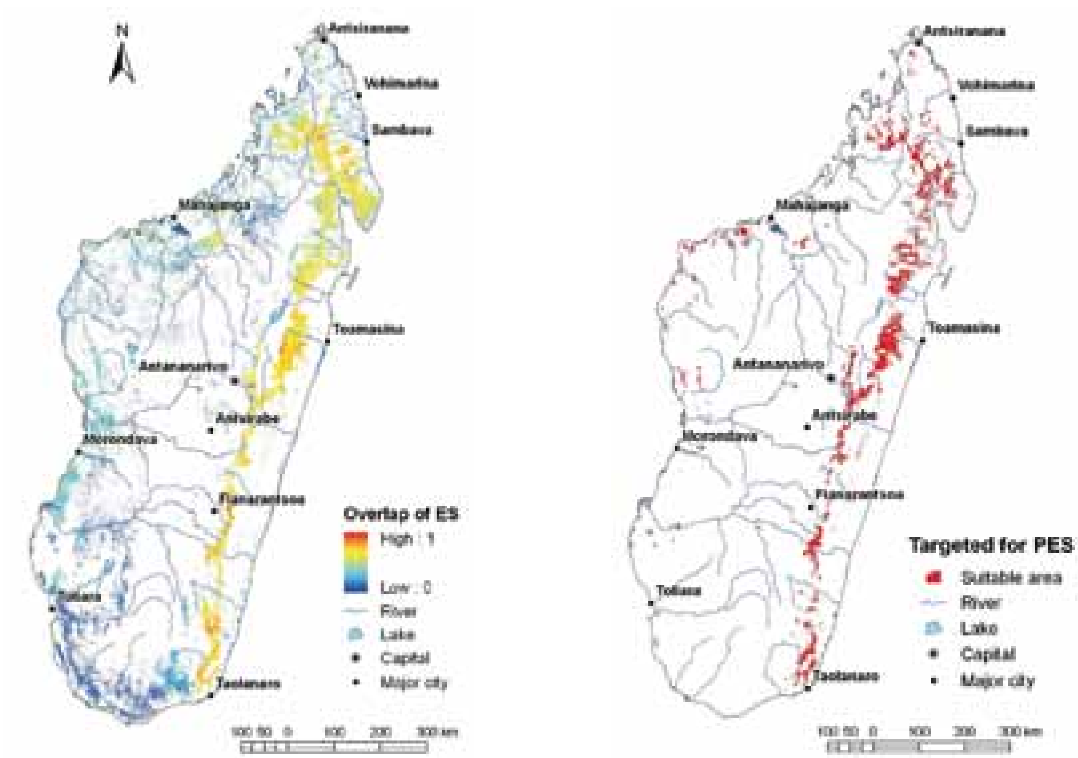
Spatial mapping tools are increasingly being used to discern the spatial heterogeneity in ecosystem costs and benefits. Several of these tools are emerging to help design PES systems at the regional and national level; however, there are increasingly initiatives of spatial mapping tools that are being developed at the international scale, including the UNEP-WCMC Carbon and Biodiversity Demonstration Atlas, ARtificial Intelligence for Ecosystem Services (ARIES),[3] the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST)[4] and SENSOR.

Spatial mapping tools are increasingly being used to discern the spatial heterogeneity in ecosystem costs and benefits

To target ecosystem service payments in Madagascar, Wendland *et al.* (2010) examined the spatial distribution of biodiversity (proxied by vector data on species ranges of mammals, birds and amphibians), carbon and water quality. The left panel of Figure 17 depicts the degree of overlap between these three ecosystem services. The right panel further incorporates information on the probability of deforestation and the opportunity cost of the land to identify where payments could be most cost-effectively targeted. One example of a spatial mapping tool developed at the international level is the Carbon and Biodiversity Demonstration Atlas, produced by the UNEP World Conservation Monitoring Centre (UNEP-WCMC) (Kapos *et al.*, 2008). The Atlas includes regional maps as well as national maps for six tropical countries showing where areas of high biodiversity importance coincide with areas of high carbon storage. Figure 18 illustrates the national map for Panama, indicating that 20 percent of carbon is stored in high carbon, high biodiversity areas.

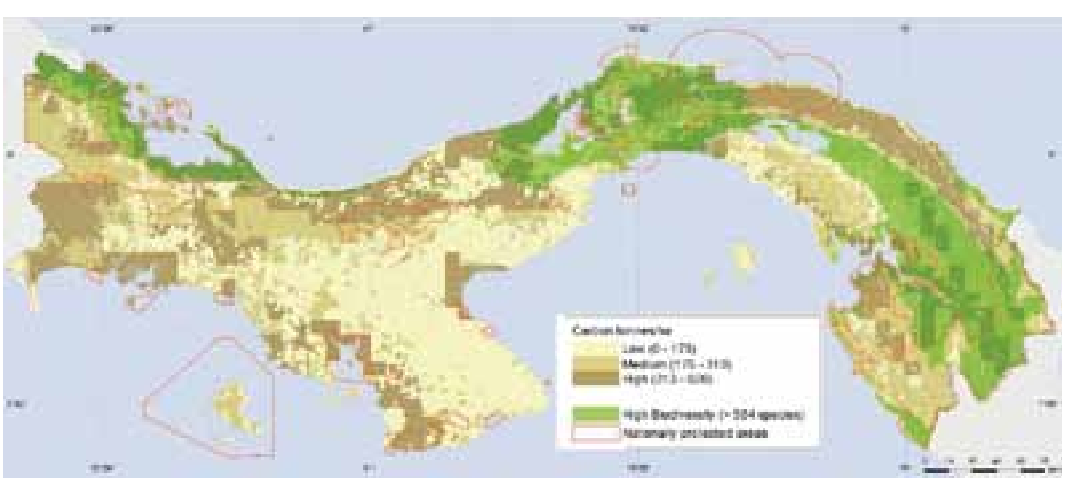
1 AUD/CVI: ratio of Australian Dollars (AUD) to the Conservation Values Index (CVI)
2 AUD/ha: ratio of Australian Dollars (AUD) per hectare of land
3 http://esd.uvm.edu/
4 http://www.naturalcapitalproject.org/

Figure 17
Targeting PES in Madagascar



Source: OECD, 2010

Figure 18
Example of a UNEP-WCMC national map: Panama



Source: OECD, 2010

To identify areas of high biodiversity importance for the regional maps, UNEP-WCMC uses six indicators for biodiversity, namely Conservation Internationals' Hotspots, WWF's Global 200 ecoregions, Birdlife International's Endemic Bird Areas, Amphibian Diversity Areas, Centers of Plant Diversity and the Alliance for Zero Extinction Sites. Areas of high biodiversity, as determined by UNEP-WCMC, are areas where at least four of the above-listed biodiversity conservation priority areas overlap, with areas in dark green indicating a greater degree of overlap.

The maps identify the different areas with high biodiversity importance. The maps do not necessarily identify areas with high biodiversity benefits in economic terms. Ideally, spatial maps on biodiversity benefits would incorporate the total economic value of these sites, with an assessment of both direct and indirect use values.

A number of spatial mapping initiatives are currently underway and are in different stages of development. These include ARtificial Intelligence for Ecosystem Services (ARIES) (Villa *et al.*, 2009); InVest (Tallis *et al.*, 2010); the United States Geological Survey (USGS) Global Ecosystems initiative;[5] and SENSOR (Sustainability Impact Assessment: Tools for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions).[6]

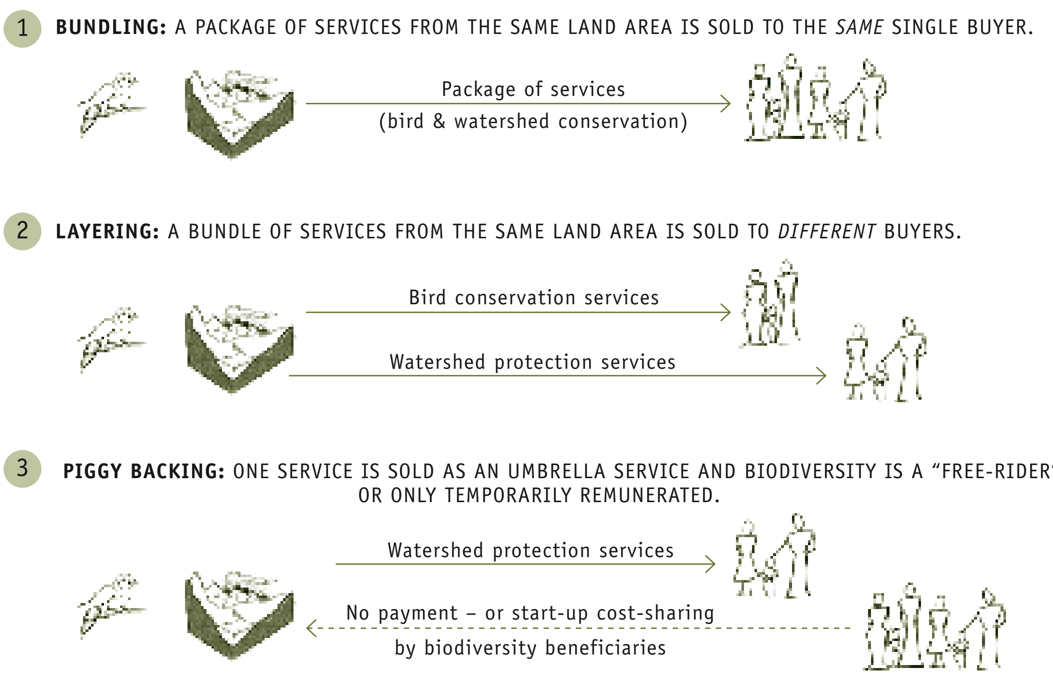
PES objectives must be clear, potential trade-offs recognised and safeguards developed to prevent adverse collateral impacts

As suggested in the Madagascar example above (Figure 17), PES programmes can simultaneously target multiple ecosystem service benefits. Bundling or layering (Figure 19) can allow a broader range of ecosystem service benefits to be obtained in a cost-effective manner, avoiding the need for multiple programmes, reducing transaction costs and programme overlap. Multiple ecosystem service provisions can help ensure that all aspects of an ecosystem on enrolled land are properly managed, increasing the asset value of the ecosystem. PES targeting multiple ecosystem services can enable the landholder to maximise potential payments received, such that conservation becomes more economically feasible, enabling greater ecosystem service provision.

The feasibility of targeting multiple ecosystem services simultaneously depends on the degree of spatial correlation between different types of ecosystem services. Spatial mapping tools help to identify where multiple service benefits coincide. Though there may often be synergies in service provision (e.g. avoided deforestation results in both biodiversity and carbon benefits), there are cases when trade-offs can also arise (Nelson *et al.*, 2008). For example, whereas native and mixed crops provide biodiversity benefits, monocultures of fast-growing tree species such as *Eucalyptus* may provide more rapid carbon sequestration benefits. Farley *et al.*

5 http://rmgsc.cr.usgs.gov/ecosystems/
6 http://www.ip-sensor.org

Figure 19
Marketing biodiversity joint service provision

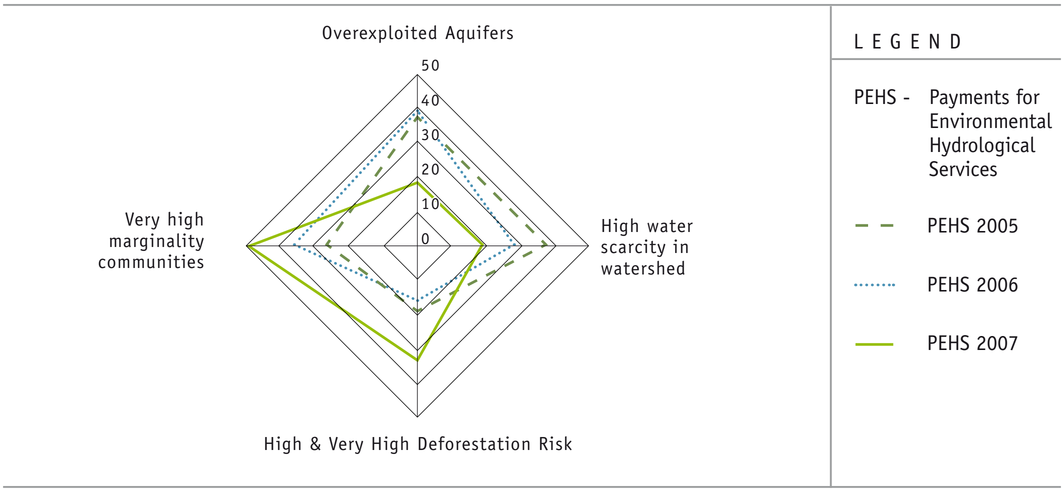


Source: OECD, 2010

(2005) highlighted this problem in West Africa, where carbon sequestration (i.e. afforestation/reforestation) projects can negatively affect water regimes and biodiversity. The ultimate objective of the PES programme must therefore be clear, potential trade-offs recognised and safeguards may be needed to prevent adverse impacts on other ecosystem services (Karousakis, 2009). In this context, environmental benefit indices and scoring approaches become not only a way of evaluating the quality of potential contract benefits, but are also mechanisms through which discrete ecosystem service priorities are traded off against each other. Any weights associated with an Environmental Benefits Index (EBI) or scoring mechanism can also be modified in sequential PES sign-up rounds to reconcile trade-offs. This has been done, for example, in the Mexican PEHS[7] programme (Figure 20) where weights have been adjusted over time to better address the policy priorities. Similar targeting methods have been used to allocate payments in the Socio Bosque programme in Ecuador. Based on a system of scores,

7 Payments for Environmental Hydrological Services (*Pago de Services Ambientales Hydrologicas - Mexico*)

Figure 20
Targeting PEHS in Mexico



Source: OECD, 2010

land area has been classified into three categories of priority: priority 1 (scoring from 12.1 to 25); priority 2 (7.1 to 12) and priority 3 (0 to 7). The scores are based on high deforestation pressure, storage of carbon in biomass, water supply and poverty alleviation.

Though these types of targeting approaches entail higher transaction costs, experience with their use suggests that the resulting cost-effectiveness gains are improved. There are also other types of PES design characteristics that can be introduced into the programme to reduce transaction costs. In the Costa Rican PES, for example, private forest landholders are required to have a minimum of one hectare to receive payments for reforestation and two hectares in the case of forest protection. The maximum area for which payments can be received is 300 hectares (and 600 hectares for indigenous peoples' reserves) (Grieg-Gran *et al.*, 2005). Aggregating small projects is also possible to help reduce the transaction costs associated with a payment contract. These types of PES design elements can help to ensure more equitable participation in the PES programme and help to reduce administrative costs.

TARGETING ECOSYSTEMS SERVICES AT RISK OF LOSS OR DEGRADATION

In addition to targeting payments to ecosystem services with the highest benefits, it is essential to ensure that any payment leads to additional benefits relative to the business-as-usual scenario. For example, payments for habitat protection are only additional if in their absence the habitat would be degraded or lost. Information on the business-as-usual or baseline scenario is critical in ensuring PES additionality. Clear understanding of whether or not ecosystem services are at risk of loss or degradation is therefore needed. Historical and current trend data on biodiversity and ecosystem service loss are a starting point and are needed to develop future reference projections. Though this can be a complex task, there are different ways this can be undertaken. For example, to target PES in Madagascar, Wendland *et al*. (2010) estimate the probability of deforestation (via a multivariate probit model) by examining distance to roads and footpaths, elevation, slope, population density, mean annual per capita expenditure and other characteristics. A similar approach is used to assess deforestation risk in the Mexican PEHS programme. In this case, the variables used to estimate deforestation risk include distance to the nearest town and city, slope, whether it is an agricultural frontier and if it is located in a natural protected area.

Information on the baseline scenario is critical to ensuring the additionality of PES projects

TARGETING PROVIDERS WITH LOW OPPORTUNITY COSTS

Finally, PES programmes can increase their cost-effectiveness if, given sites with identical ecosystem service benefits and risk of degradation or loss, payments are differentiated and prioritised to those sites where landholders have lower opportunity costs of alternative land uses. In the Costa Rican PES, for example, Wunscher *et al.* (2006) illustrate that differentiating payments according to opportunity costs could allow the enrolment of almost twice the area of land, representing more than double the environmental benefits per cost (see Case Study 5 “PES in Costa Rica”).

Obtaining accurate information on ecosystem providers’ opportunity costs is not straightforward as they have an incentive to overstate these costs in an effort to extract information rents via higher payments. Programme administrators have a number of options to assist revelation of the landholder’s true opportunity costs. Specifically, they can gather additional information in the form of costly-to-fake signals or they can use inverse auctions.[8]

Information on ecosystem supplier attributes and activities which are correlated with their opportunity costs can be used to infer the correct price. The information should be based on costly-to-fake signals, for example, distance to markets, current land use, assessed value, or labour and production inputs. Readily available market information can also be used and incorporated into a model to estimate opportunity costs. In the USA Conservation Reserve

8 Screening contracts can be used in theory, but this is complicated in practice; see Ferraro (2008)

Program, for example, local land rental rates are combined with information on field soil types, a proxy for productivity, to give a reasonable indication of the opportunity costs of retiring agricultural land. This is then used as a maximum acceptable price, removing the landholders' ability to claim unreasonably high payments. To proxy for opportunity costs in Madagascar, Wendland *et al.* (2010) use data on the opportunity costs of agriculture and livestock produced by Naidoo and Iwamura (2007). Naidoo and Iwamura compiled information on crop productivity and distribution for 42 crop types, livestock density and estimates of meat produced from a carcass and producer prices to measure the gross economic rents of agricultural land across the globe. Wendland *et al.* (2010) clipped this global data to Madagascar's boundaries. Gross economic rents ranged from USD 0 to 529 per hectare for Madagascar, with a mean value of USD 45 per ha, per year. The value of USD 91 per ha, per year (one standard deviation) was used as the cut-off to exclude areas of high opportunity costs.

However, obtaining information on costly-to-fake signals still incurs research costs. The efficiency of the payment will directly depend on the quality of this research and the strength of the correlation between the signal and the opportunity costs, which must be assessed on a case-by-case basis.

Exploiting competition between ecosystem service suppliers for conservation contracts through inverse auctions can provide an effective cost-revelation mechanism. Where suppliers are heterogeneous in their opportunity costs and demand for contracts exceeds supply (i.e. the conservation budget), competitive procurement auctions are possible.

The recognition of the potential gains from the use of inverse auctions as a payment allocation mechanism has stimulated heightened interest from policy-makers. Though their use in PES programmes is not yet common, they are becoming more widespread in developed and developing countries. Inverse auctions have been used to allocate PES contracts in Australia, Canada, Finland, Germany, Indonesia, Tanzania, the United Kingdom and the USA (Claassen, 2009; DSE, 2009; EAMCEF, 2007; Hill *et al.*, 2011; Jack, 2009; Juutinen and Ollikainen, 2010; Latacz-Lohmann and Schilizzi, 2005).

REFERENCES

Claassen, R. 2009. *USDA briefing room - Conservation policy: Background* (available at http://www.ers.usda.gov/briefing/conservationpolicy/background.htm).

DSE (Deparment of Sustainability and Environment). 2009. *ecoMarkets, Virginia, Australia*, Vol. 11, pp. 1565–1576 (available at http://www.dse.vic.gov.au).

EAMCEF (Eastern Arch Mountains Conservation Endowment Fund). 2007. *Welcome to the Eastern Arc homepage* (available at http://www.easternarc.or.tz/).

Farley, K., Jobbagy, E. & Jackson, R. 2005. Effects of afforestation on water yield: A global synthesis with implications for forestry. *Global Change Biology*, 11.

Ferraro, P. 2008. Asymmetric information and contract design for payments for environmental services. *Ecological Economics*, 65(4): 810–821.

Grieg-Gran, M., Porras, I. & Wunder, S. 2005. How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. *World Development*, 33(9): 1511–1527.

Hill, M., McMaster, D., Harrison, T., Hershmiller, A. & Plews, A. 2011. A reverse auction for wetland restoration in the Assiniboine River watershed. *Canadian Journal of Agricultural Economics*, 1: 1–14.

Jack, B.K. 2009. *Auctioning conservation contracts in Indonesia: Participant learning in multiple trial rounds*. CID Graduate Student and Research Fellow Working Paper, No. 35. Center for International Development at Harvard University.

Juutinen, A. & Ollikainen, M. 2010. Conservation contracts for forest biodiversity: Theory and experience from Finland. *Forest Science*, 56: 201–211.

Kapos, V., Ravilious, C., Campbell, A., Dickson, B., Gibbs, H., Hansen, M., Lysenko, I., Miles, L., Price, J., Scharlemann, J.P.W. & Trumper, K. 2008. *Carbon and biodiversity: A demonstration atlas*. Cambridge, UK, UNEP-WCMC.

Karousakis, K. 2009. *Promoting biodiversity co-benefits in REDD*. OECD Environment Working Paper Series, No. 11. Paris, OECD.

Latacz-Lohmann, U. & Schilizzi, S. 2005. *Auctions for conservation contracts: A review of the theoretical and empirical literature*. Report to the Scottish Executive Environment and Rural Affairs Department.

Muñoz Piña, C., Guevara, A., Torres, J. & Brana, J. 2008. Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. *Ecological Economics*, 65(4): 725–736.

Naidoo, R. & Iwamura, T. 2007. Global-scale mapping of economic benefits from agricultural lands: Implications for conservation priorities. *Biological Conservation*, 140: 40–49.

Nelson, E., Polasky, S., Lewis, D., Plantinga, A., Lonsdorf, E., White, D., Bael, D. & Lawler, J. 2008. Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape. *Proceedings of the National Academy of Sciences*, 105(28): 9471–9476.

Pagiola, S. 2006. Payments for environmental services in Costa Rica. *Munich Personal RePEc Archive.*

Tallis, H.T., Ricketts, T., Nelson, E., Ennaanay, D., Wolny, S., Olwero, N., Vigerstol, K., Pennington, D., Mendoza, G., Aukema, J., Foster, J., Forrest, J., Cameron, D., Arkema, K., Lonsdorf, E. & Kennedy, C. 2010. *InVEST 1.004 beta user's guide*. Stanford, The Natural Capital Project.

Villa, F., Ceroni, M., Bagstad, K., Johnson, G. & Krivov, S. 2009. *ARIES (Artificial Intelligence for Ecosystem Services): A new tool for ecosystem services assessment, planning and valuation*. Proceedings of the 11th Annual BIOECON Conference on Economic Instruments to Enhance the Conservation and Sustainable Use of Biodiversity.

Wendland, K. 2008. Rewards for ecosystem services and collective land tenure: Lessons from Ecuador and Indonesia. *Tenure Brief*, 9: 1–10.

Wendland, K.J., Honzak, M., Portela, R., Vitale, B., Rubinoff, S. & Randrianarisoa, J. 2010. Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar. *Ecological Economics*, 69(11): 2093–2107.

Wunscher, T., Engel, S. & Wunder, S. 2006. Payments for environmental services in Costa Rica: Increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture*, 45(4): 317–335.

PES IN COSTA RICA

Katia Karousakis and Quiller Brooke
Organisation for Economic Co-operation and Development (OECD), Paris, France

Reproduced with permission from:
OECD, 2010. "Cost-effective targeting of payments for ecosystem services",
in Paying for Biodiversity: Enhancing the Cost-Effectiveness of Payments for Ecosystem Services.
OECD Publishing. Also available at http://dx.doi.org/10.1787/9789264090279-8-en

In 1996, Costa Rica replaced an ineffective system of tax deductions for reforestation with a PES programme. Funded by oil tax revenues, the World Bank, the GEF and the German aid agency KfW, the programme enrols land to protect areas of natural forests, establish sustainable timber plantations, regenerate natural forests and establish agroforestry systems. The aim is to incentivise the provision of carbon sequestration, water quality, biodiversity protection and scenic beauty services on private land.

Between 1997 and 2005 forest protection was supported on 1.1 million acres and timber plantations on 67 000 acres. The programme gives a uniform per acre payment level irrespective of the quality or quantity of the ecosystem services provided. Contracts are prioritised according to predefined spatial criteria, including, officially acknowledged biological corridors, private property located within protected areas, zones with a low social development index and expiring contracts (Pagiola, 2006).

Wunscher *et al.* (2006) analysed the Costa Rican PES programme and demonstrated that there are potential gains from employing a more discerning contract selection process, together with differentiated payments. The study focused on the Nicoya Peninsula in northwestern Costa Rica. Plots were scored, giving equal importance to carbon sequestration, water quality, biodiversity protection, scenic beauty and poverty alleviation benefits (Figure 21). Three selection processes were simulated for comparison: a baseline scenario designed to match the current system and two scenarios selecting the highest scoring sites, one with uniform payments and one with differentiated payments relative to estimated opportunity costs (Table 6).

The uniform payment scenario enrolled 14 percent higher benefits than the baseline scenario, at the same cost, while the flexible payment scenario enrolled almost twice the land area (197 percent), giving more than double the benefits (203 percent). Moreover, the flexible scenario was able to use savings from the efficient pricing of low quality sites to fund the enrolment of higher quality sites.

Table 6
Comparison of scenarios for different payment schemes

	Baseline	Uniform payment	Flexible payment
Payment	Uniform	Uniform	Differentiated
Selection criteria	Priority area	Environmental score	Environmental score
Total cost (USD)	69 476 (100%)	69 429 (99.9%)	69 471 (99.9%)
Area (ha)	1 736.9 (100%)	1 735.7 (99.9%)	3 417.8 (196.8%)
Environmental score	27 421 (100%)	31 325 (114%)	55 724 (203%)
Score per USD	0.395 (100%)	0.451 (114%)	0.802 (203%)

Source: OECD, 2010

REFERENCES

Pagiola, S. 2006. Payments for environmental services in Costa Rica. *Munich Personal RePEc Archive*.

Wunscher, T., Engel, S. & Wunder, S. 2006. Payments for environmental services in Costa Rica: Increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture*, 45(4): 317–335.

Current pages (from left to right):

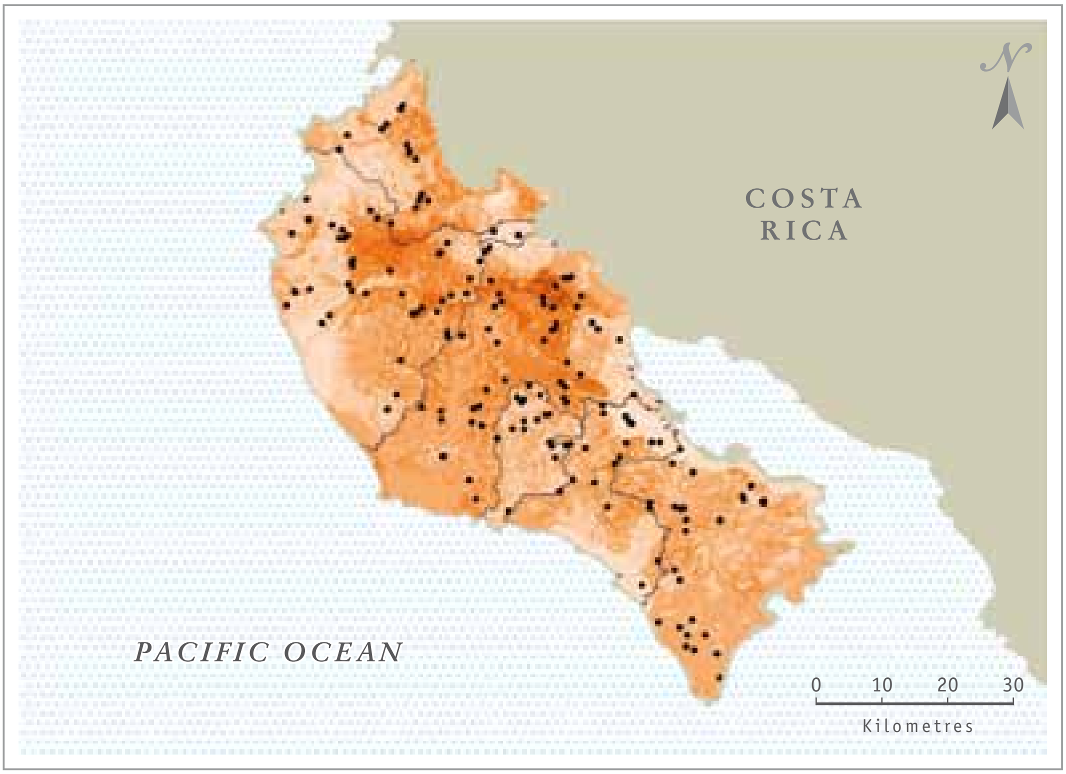
→ Coffee production in Costa Rica is suited to the soil and bio-climatic conditions of the central Meseta region, but increasing export demand has spread cultivation and consequent deforestation to the forested hilly areas.

→ Rainforest at Monteverde, Costa Rica, where a single tree can reach over 40 metres height.

→ The malachite butterfly (*Siproeta stelenes*), an example of the high diversity of Lepidoptera in Costa Rica, home to more than 1 200 butterfly species and more than 8 000 moth species.

Figure 21

Average cumulative score of different ecosystem services and poverty alleviation benefits together with coordinates of interviews carried out in different land properties within the Nicoya Peninsula



LEGEND

interview coordinate	
administrative boundaries	

Score

0–0.40	1.20–1.60	2.41–2.81
0.40–0.80	1.60–2.01	2.81–3.21
0.80–1.20	2.01–2.41	3.21–3.62

Adapted from original map by Tobias Wünscher (University of Bonn)

CHAPTER

5

SOCIAL AND CULTURAL DRIVERS BEHIND THE SUCCESS OF PES

Sarah Bekessy and Benjamin Cooke
Royal Melbourne Institute of Technology (RMIT)
Melbourne, Australia

CONTENTS

ABSTRACT

Despite the potential for social and cultural drivers to profoundly affect PES outcomes, these issues are often neglected in programme design. A discussion is presented of some key motivational drivers that can impact stakeholders' interest towards PES programmes and that affect stakeholders' engagement in and commitment beyond these programmes. In particular, the stakeholders' interest will be highly influenced by non-economic considerations, cultural links between local identity and land use, diminishing altruistic actions through motivational crowding out, developing competition in the place of cooperation, mistrust of government agencies, failing to account for existing social and institutional frameworks, and the important role of capacity building. A fundamental issue is that participants in PES are unlikely to get involved solely for economic reasons; indeed, participation in PES is rarely cost-effective compared with alternative land uses. Offering non-financial benefits in PES programmes, such as capacity-building, is likely to be pivotal to stakeholders' engagement in and commitment beyond the programmes. Some suggestions are also presented for incorporating the social context into the PES design and implementation process to enhance investment efficiency and long-term ecological benefit.

INTRODUCTION

Consider the following hypothetical scenarios: a PES system in Australia creates antagonism when it becomes apparent that one landholder is being paid for management actions which a neighbour has been doing for years without any financial incentive. A PES scheme aiming to encourage biodiversity conservation in Vietnam requires villagers to cease farming practices that form a part of their identity as land users. A reverse auction in India faces a stumbling block when it becomes apparent that the majority of landholders are putting everything they earn into efforts to move away to an urban settlement. In all of these plausible scenarios, PES schemes may struggle to achieve the desired ecosystem services outcome due to neglect of the local social context and motivational drivers. Here, it can be argued that the social dimensions of PES can play a critical role in determining our ability to realize ecological objectives. PES is being used to pursue an increasing array of ecosystem service goals by governments and non-governmental organizations in both the developed and developing country contexts. The ecosystems services being paid for include biodiversity, carbon capture, watershed management, soil conservation and erosion control and, more recently, landscape

Key motivational drivers trigger stakeholders' interest in PES, as well as engagement and commitment in and beyond PES programmes beauty. This diversity adds significant complexity to discussions surrounding socio-cultural and motivational issues that contribute to PES success. As such, a discussion is presented on what is believed to be the key 'intangible' issues contributing to PES that have traditionally been undervalued in the design of PES initiatives. These include key motivational drivers that can impact stakeholders' interest towards PES programmes and that affect stakeholders' engagement in and commitment beyond these programmes. In particular, the stakeholders' interest will be highly influenced by non-economic considerations, cultural links between local identity and land use, diminishing altruistic actions through motivational crowding out, developing competition in place of cooperation, mistrust of government agencies, failing to account for existing social and institutional frameworks and the important role of capacity building.

This discussion informs a scaffold of suggestions for thinking about how these issues might be built into the PES design and implementation process, intended to be applicable across a range of socio-cultural settings.

RAISING STAKEHOLDERS' INTEREST TOWARDS PES PROGRAMMES

Real people are not always economically rational operators

It is self-evident that for PES schemes to achieve their stated objectives, individuals or collectives have to actually want to participate in the initiative. While this basic premise of PES assumes it is the financial payment providing the encouragement to people to protect or enhance a natural resource (Van Hecken and Bastiaensen, 2010), it may not be the sole participatory driver. The 'value' placed on ecosystem services by communities often extends beyond direct use values, encapsulating existence value, non-use and option use values (Chee, 2004). Capturing and reflecting these multiple values in PES may be critical in attracting land users to participate in a scheme. Financial incentives may also be insufficient to mask potential conflict or mistrust between the agency offering the scheme and the intended participants. Programmes offering financial incentives to farmers for water quality improvements in the USA failed to achieve sufficient participation for this very reason (Breetz *et al.*, 2005). Farmers viewed the policy and the lack of consultation in its development as inequitable, contributing to the already-strained relations between farmers and programme coordinators. Moreover, the means by which the programme was communicated to farmers inhibited their ability to imagine how the programme might actually operate in the context of local conditions and their individual properties. In the case of a scheme that is poorly communicated to potential participants or a lack of trust between landholders and scheme administrators, individuals may view a programme as too risky to adopt.

The assumption is that people will rationally weigh the economic costs and benefits of programme participation before deciding to participate masks the potential complexity of motivational drivers. PES may require alterations to behaviour or land-use practices, which may be strongly embedded in the identity of local people (Wendland, 2008). For example, farmers, family forest owners and local communities may have generational linkages to certain methods of harvesting, food production and land management that constitute more than simply an income, but rather a way of life. A PES scheme that takes limited account of such a context may be less attractive to potential participants, despite the opportunity for economic benefit. The relevance of non-financial motives is further emphasized when one considers the alternative scenario; people can also be willingly participate in PES programmes despite the money they receive being less than the opportunity cost forgone from not farming or exploiting the land in the manner they otherwise would (Kosoy *et al.*, 2010). Landholder motivations can vary markedly across different regions and global contexts, but also within a single geographical location. The USA, UK and Australia, like many post-industrial nations, are experiencing a shift in property ownership, with rural areas of high amenity value recording significant levels of in-migration from non-farming landholders (Barr, 2005; Gill *et al.*, 2010). PES programmes that target biodiversity gains in rural areas with a decreasing presence of agriculture would need to be cognisant that property owners may have heterogeneous, non-farming-related property management goals. Landholders in these regions may lack the practical land management capacity required to undertake management actions present in a more traditional farming landscape (Pannell *et al.*, 2006).

Targeting PES schemes for different groups of stakeholders requires considering different sets of motivational drivers

On the flip-side, highly productive agricultural areas in large parts of world, including Australia and the USA, have been purchased by large agri-corporations (UNCTAD, 2009). Targeting PES schemes to each of these very distinct groups — hobby farmers and agri-corporations — will require consideration of a very different set of motivational drivers. Different incentives may be required to draw participation and the level of information and training support offered to participants will also need to be considered. For example, hobby farmers choosing to move from the city to take up a rural lifestyle may be more likely to respond positively to non-financial incentives, such as advice from extension officers. Agri-corporations may be motivated by financial incentives, but may require continued payment to ensure the longevity of investments. In the sections below, some of the major pitfalls of ignoring the social dimensions and motivational drivers for participation in PES schemes are highlighted and some ways forward are suggested.

Motivational crowding-out

Motivational crowding-out is a known phenomenon, where altruistic motives are replaced by self-interested, extrinsic motivations. Motivational crowding-out can also relate to ecosystem services and can be triggered by a poor non-participatory implementation of PES schemes. Ecosystem services are common goods in that society at large benefits from their provision. It may be the case that individuals and communities are altruistically motivated to provide carbon capture or biodiversity ecosystem services out of a sense of moral or ethical responsibility (Bowles, 2008).

Understanding the existing motivations for the adoption of pro-conservation behaviour can prove invaluable. There is a possibility that many of the conservation actions required of a community involved in PES are already being conducted prior to the introduction of an economic incentive to do so (Murray *et al.*, 2007). If a PES programme is only seeking to recruit select individuals or landholders within a given community, they may be receiving a financial reward for the same practice that others are intrinsically motivated to do. The danger in such a scenario is that this intrinsic motivation will be undermined, as individuals' motivations become more orientated towards self interest, rather than a moral responsibility (Bowles, 2008).

One of the biggest concerns posed by motivational crowding-out is that the cumulative losses of ecosystem service benefits caused by diminishing altruistic motivations are greater than the benefits produced by those participating in PES. Once intrinsic motivations have been discouraged, the resulting landholder disillusionment with the process or with the scheme administrators involved appears to be difficult to reverse (Hatfield-Dodds and Proctor, 2008). Disillusioned landholders may also be less inclined to participate in future initiatives. The risk of eroding altruistic motivations highlights the need to assess the extent to which PES schemes can balance competition for funds with collaborative management practices at a landscape or regional scale. By recognizing existing intrinsic motives, PES programmes can be designed to build on existing voluntary efforts, rather than discouraging them. Simply replacing voluntary motives with extrinsic incentives does not represent efficient or effective policy and potentially proves counter-productive to conservation goals (Hatfield-Dodds and Proctor, 2008). Structuring programmes to pick up on existing intrinsic motives for sustainable practices is likely to have a greater chance of success (Clements *et al.*, 2010).

Motivational drivers triggered by cooperation versus competition

Collective action by communities for the management of ecological resources is a strong and established tradition in many parts of the globe. This encompasses a spectrum from indigenous communities in a communal land rights context, to volunteer watershed management groups amidst private property rights regimes. The extent to which community-based natural resource management across differing land tenure systems could be undermined by selective payments to individuals within a collaborative network could impact on the success of a PES scheme. Competition may be introduced into the process at three distinct phases: (a) access to a programme that may have limited funds available; (b) defining land tenure where it was previously undefined; and (c) the equity of the amount of payments received by each individual participant (see also Chapter 3 "Opportunities and gaps in PES implementation and key areas for further investigation").

Within a system of customary land tenure, there may be little incentive to clearly define property rights and boundaries, as no economic incentives exist to do so (Wendland, 2008). PES schemes have the potential to provide that incentive, inducing a change to social perceptions of ownership and property rights (Gong *et al.*, 2010). Avoiding disputes over property boundaries and a consciousness of the capacity to alter communal property rights regimes should be addressed when considering how PES contracts are going to be structured (Kosoy *et al.*, 2007). This may involve payments into a community fund for ecosystem services to be delivered by the whole community, rather than through discrete contracts with individuals. Alternatively, in the context of reverse auctions, preference could be given to contractors who present combined bids that span a target region to encourage collaboration. Whatever the format, it seems clear that land tenure arrangements need to be determined and defined before PES contracts are entered into, as PES participation may increase the value of the land and raise the potential for associated tenure disputes.

PES implementation can trigger competition in potential participants in access to the programme under certain conditions

Depending on the land tenure and management context, the structure of payment mechanisms can impact local normative behaviour. A programme that encourages cooperation may see normative benchmarks for sustainable land management strengthen, giving participants a standard against which they can assess their own performance (Lokhurst *et al.*, 2010). One criticism of reverse auctions as a PES mechanism is the confidentiality and individuality of the bidding process, as well as potentially limited awareness of fellow participants. It may be difficult to build on local normative behaviour when neighbours are unaware of each others' activities.

PES programmes may also encounter problems from strategic behaviour by potential participants who seek to take advantage of the introduction of an economic incentive for land management (Ferraro, 2001). Landholders may respond to incentives by degrading their land, in the hope of receiving payments for future programmes. Landholders with existing capital may also engage in land speculation with the intention of attracting PES payments across multiple land parcels. Ferraro (2001) raises the issue of in-migration motivated by PES; people might immigrate to a location where a PES programme is being considered, in the hope of being granted property rights for their allocation as part of the implementation process.

Despite the potential for rupturing collective action efforts, PES can also open lines of communication between ecosystem service users and providers. This may be especially relevant in contexts where water quality, biodiversity and land-use practices of poorer communities in mountainous upper catchment regions are impacting wealthier end-users of those services. For example, PES appears to have played some role — while difficult to quantify — in creating greater awareness of the interconnectedness of resource management and community development issues in Honduras (Kosoy *et al.*, 2007). End-users pay a small surcharge on their water bills, which is paid to upland farmers to limit conversion of forest to coffee plantations, with the intention of improving the quality of drinking water (see also Case Study 12 "PES for improved ecosystem water services in Heredia town, Costa Rica").

The influence of existing institutional frameworks and social networks on participatory motivations

What has come before in terms of development projects, land-use policy or incentive schemes will likely have an impact on how communities respond to a new PES scheme. This includes influencing the individuals who are likely to actually participate in a programme. As Daniels *et al.* (2010) found in the case of Costa Rica's forestry PES scheme, landholders who were previously involved with incentives or conditional forestry subsidies were disproportionately represented in PES. Moreover, 60 percent of landholders not involved in PES in the same province were completely unaware of the existence of the programme. In the case of PES in Vietnam, early community perceptions of the objectives of the programme were shaped by the widespread implementation of an existing illegal forestry monitoring programme, which employed a number of people in villages across the region (Petheram and Campbell, 2010). This highlights the extent to which institutional path dependency and existing social networks can dictate participatory outcomes. This is not always a bad thing; using existing networks may provide an appropriate avenue for targeting individuals and communities who are appropriate candidates for participation. However, PES schemes need to be cognisant of individuals and communities outside of established social and institutional frameworks, and who may be the custodians of ecological assets that are crucial to the success of the project. Given that the pursuit of additionality is considered a key component of PES, engaging these 'outsiders' may help to achieve ecological gains that would not have otherwise occurred without financial incentives.

> ***PES design should involve the actual custodians of ecological assets deemed crucial in the preservation of ecosystem services***

Connecting to landholders outside of existing social and institutional networks can add an extra layer of organizational complexity to PES schemes. This complexity can be heightened when a strong sense of community mistrust — warranted or unwarranted — may be present towards the conservation agency, government department or private institution that is behind the PES initiative. Private land conservation programmes in the USA appear to have had some success with using intermediaries that were already trusted by the community (such as respected local farmers or foresters) as the communicators of such programmes. The first point of contact with a potential participant can be a crucial determinant in programme adoption (Wilcove and Lee, 2004). While non-governmental organizations (NGOs) often act as intermediaries for PES programmes in developing nations, organizations with existing social and trust networks established may be in a good position to begin discussions with the community about the potential for PES schemes.

The legitimacy of the PES scheme amongst the community may be just as important as the perceived legitimacy of the agency providing it. In some cases, a PES programme may be proposed in region where pre-existing voluntary conservation initiatives have been in operation for a number of years. De-emphasizing a long standing programme in which people have invested a substantial amount of their time and money in favour of a PES scheme may leave some communities feeling disenfranchised. Devising ways of integrating PES with an existing successful programme with a governance structure that could make PES implementation viable could prove a more efficient way of delivering outcomes on the ground.

ENSURING STAKEHOLDERS' ENGAGEMENT IN PES PROGRAMMES

If stakeholders are not involved in the design and implementation processes of a PES scheme, the likelihood that participants will adhere to the requirements of a contract is reduced. This is often the result of landholders not being fully aware of the contractual requirements until after agreeing to participate, at which time it might be realized that they do not possess the capacity to complete the tasks.

Community consultation provides an opportunity to gauge the capacity of landholders to participate in a PES programme, while also providing a space in which misunderstandings about the programme can be rectified and existing attitudes and concerns within the community about pressing land management issues can be determined. The ability to deal with unforeseen issues that could inhibit adoption or adherence to PES contracts may help to mitigate the risk of PES failures. A scoping study that encapsulates these social dimensions should be included alongside biophysical assessments of the suitability of a location for PES (Petheram and Campbell, 2010). Scoping might identify a host of governance and land tenure conflicts that need to be resolved before PES could be implemented without fear of initiating community tensions.

Community consultation also provides an avenue for local knowledge about ecosystems and land management to be integrated into PES design. Imposing a method of practice that is not suited to local conditions may prove counterproductive and diminish community trust or confidence in the scheme. Engaging stakeholders can be valuable in identifying local practices that can be integrated into PES programme design. Integrating local knowledge and practices could prove pivotal to local people buying into the objectives of the programme. A PES programme aimed at biodiversity conservation in northwestern Ecuador spent nearly 12 months working with local communities before contracts were established; this shows the importance of a thorough and honest engagement that is not simply an exercise in pacifying community concerns (Wendland, 2008).

FOSTERING STAKEHOLDERS' COMMITMENT BEYOND PES PROGRAMMES

As is reinforced by the OECD (2010), once payments for ecosystem services cease, individuals may lose the motivation or capacity to continue providing those services. Continuous payments and additional funding clauses are suggested as a way of increasing the likelihood that gains will be permanent. However, in a review of 13 different PES programmes globally (Wunder *et al.*, 2008), nine had contract periods of ten years or less. While three of the nine had renewal clauses for extension of contracts, it suggests that finite contract periods are currently a political reality in many cases. Assuming a continuing trend of finite contract periods, the question then becomes one of how the likelihood of permanency can be enhanced in the event of payment termination or renegotiation of contract conditions.

Establishing capacity building and offering non-financial benefits in PES programmes is also likely to be pivotal to providing prolonged and sustainable changes to land-use practices. Individuals and communities may not have the capacity to actually undertake the actions required through PES without increased knowledge, training and equipment. Determining the non-financial constraints to practice change could be identified in a scoping study. Non-financial benefits may help to build greater community resilience and reduce sole reliance on direct payments for producing ecosystem service benefits (see also Chapter 6 "Landscape labelling approaches to PES: Bundling services, products and stewards").

Capacity building and non-financial benefits are pivotal to providing prolonged and sustainable changes to land-use practices

While fostering stewardship amongst participants is no guarantee of permanency, it may increase the likelihood of continued gains. Moreover, if PES programmes allow for clarification and greater security of land tenure, while increasing the capacity of landholder to deal with land management issues, increased stewardship may be a beneficial by-product (Muradian *et al.*, 2010). Increasing the level of ownership that individuals and communities have in their PES project may help to foster this sense of stewardship.

One interesting question raised by PES is whether programmes that are simply aimed at use avoidance (e.g. stopping logging or farming) can be sustained in the long term. It may be a reality for some communities that the withdrawal of PES will necessitate the resumption of previous practices to maintain livelihoods. Ultimately, multi-dimensional programmes that do not rely solely on the avoidance of the use of a particular resource may prove more sustainable. This issue is neatly captured by a quote from a villager in Petheram and Campbell's research into the potential for PES in a highland region of Vietnam: "Even if the government pays, the peoples' habit is to grow crops. People don't want to sit here and do nothing" (Petheram and Campbell, 2010).

The extent to which identity and existence is tied to land use will undoubtedly play a role in PES success, especially when the actions being requested require a sudden and complete change in long established resource use traditions.

OVERALL EFFECT OF MOTIVATIONAL DRIVERS ON PES SUCCESS

PES schemes have been heralded as a mechanism for achieving greater economic and ecological efficiency in environmental investment (OECD, 2010). However, perceived efficiencies can be quickly eroded through failure to understand the social dimensions of PES. Motivational crowding out is one example of the unintended consequences of PES that can have lasting effects on the success of natural resource management initiatives.

Understanding and responding to the intangible motives for PES participation can substantially improve the economic and ecological efficiency of investments. As Kosoy *et al*. (2007) point out, the opportunity costs that are forgone as part of PES participation are often higher than the PES payments, so something in addition to financial incentives must be driving decisions. Anecdotal evidence from reverse auction tender programmes in Australia suggests that some landholders willingly change their practices when provided with information and assistance from extension officers as part of the bidding process. This accords with evidence from family forestry properties in the USA, where extension services were rated by landholders as more critical than financial incentives for practice change (Kilgore *et al*., 2007). This also raises the question of whether PES programmes are paying participants too much. Would participants be just as happy with less money and more investments in improving their knowledge and capacity? Moreover, given the apparent importance of extension, are PES programmes that neglect to include such a focus as part of participation setting up the participants for failure?

Opportunity costs are often higher than PES payments, so something else must be driving interest and participation

Given that financial constraints often play a role in natural resource management decisions in government, it will be useful to identify PES designs that achieve superior ecological outcomes with the equivalent amount of money. It is argued that researching the social landscape before launching a PES scheme will provide insights that can substantially improve the economic and ecological efficiency of investments both in the short and longer terms.

INCORPORATING THE SOCIAL DIMENSION AND MOTIVATIONAL DRIVERS INTO PES DESIGN

A general framework for PES implementation is destined to fail on the ground. The variation in socio-economic drivers, attitudes and motivation between individuals and communities globally means the design and implementation of PES must consider the social dimension in order to reduce the risk of inefficiencies and failure to produce the desired outcomes. While this is something that PES practitioners and intermediaries are acutely aware of, PES design at an institutional level is only beginning to grapple with these inherent complexities. We argue that each time a PES programme is designed and implemented, it is necessary to integrate the social landscape with the biophysical landscape. Below we outline some guidelines for PES that are intended to help both reveal and navigate through the conflicts and intangibles discussed above.

Scaffold of key questions and suggestions

a. **A scoping study of the social dimensions of PES** should be included alongside biophysical assessments of the suitability of a location for PES. Questions that should be posed include:
   - Have there been previous experiences with natural resource management policy that will influence participation? Are there obstacles that have to be overcome to regain trust? Is there potential to crowd out existing intrinsically motivated conservation action?
   - Are property rights well established? Will they need to be clarified before PES is introduced? Is there potential for PES to create conflict around property rights? Is it possible to target groups of landholders in a cooperative arrangement?
   - Can existing networks and trusted agency/landholder relationships be utilised to communicate the broader programme goals, or even to garner interest in participating in stakeholder engagement for the development of shared goals? Are 'outsiders' going to be important to broad programme objectives?
   - What is likely to drive participation? Are landholders predominantly families running marginal businesses, hobby farmers, agri-business? Will landholders respond to investments in improving their knowledge and capacity as part of the financial incentives offered?

b. PES can be thought of as an **instrument of behavioural change**. There is a large literature around the use of social psychology principles to achieve behavioural change, with frameworks such as Community-Based Social Marketing (CBSM) (McKenzie-Mohr and Smith, 1999) having the potential to guide programme development. Some key elements of CBSM include setting clear goals, identifying and overcoming obstacles, encouraging public commitment making, creating norms and providing tailored feedback. Some powerful insights can flow from adopting this approach. For example, it may become apparent that obstacles to achieving land-use change are not purely financial, so education and extension may need to play a role. Another insight may relate to norms: PES schemes that utilise reverse auctions that are undertaken competitively and confidentially will struggle to create norms because neighbours will not be aware of each others' activities.
c. **Involving stakeholders in the development of PES programmes** is likely to create goodwill and establish relationships with landholders that will be invaluable in the implementation phase (Cooke *et al.*, in review).
d. **Defining clear objectives** is critical to determining how best to engage landholders. For example, if an objective of the scheme is to target spatially prioritised zones, it may be critical to ensure participation from specific landholders or it could be desirable to engage groups of landholders. Social objectives will also influence programme design: How prominent are pro-poor objectives? Will the programme target those who have not participated in other schemes? Is the objective to encourage change in those who may have historically neglected land (achieving additionality) or is the programme a reward for good land management practices?
e. **PES is not the only mechanism for achieving land-use change** and may not be the most efficient and effective approach in all situations. Simple models of ecological and social processes can be used to evaluate the efficiency of PES over alternative policy approaches (see, for example, Ferraro and Pattanayak, 2006; Polasky *et al.*, 2005). Elements of other policy approaches (regulation, voluntary extension programmes) can be built into PES to increase participant capacity and the sustainability of outcomes.

CONCLUSIONS

By highlighting the array of local social context and motivational dimensions that can shape the success of PES schemes, we have sought to demonstrate the need for more nuanced thinking about policy design and implementation. A useful way of conceptualising the range of issues discussed here is to consider engaging with landholders, communities, existing policy frameworks and other relevant stakeholders as a risk aversion strategy. It is argued that the risk of failure in terms of inefficiency and damaging perceived legitimacy of policy amongst the community can be reduced by an early and honest engagement with affected communities. Indeed, as the examples cited here suggest, it is crucial for achieving tangible social and ecological gains that advance sustainable land management in communities across the globe.

REFERENCES

Barr, N. 2005. *The changing social landscape of rural Victoria*. Bendigo, Victoria, Department of Primary Industries.

Bowles, S. 2008. Policies designed for self-interested citizens may undermine 'the moral sentiments': Evidence from economic experiments. *Science*, 320: 1605–1609.

Breetz, H.L., Vanden, K.F., Jacobs, H. & Schary, C. 2005. Trust and communication: Mechanisms for increasing farmers' participation in water quality trading. *Management Review*, 81(2): 170–190.

Chee, Y.E. 2004. An ecological perspective on the valuation of ecosystem services. *Biological Conservation*, 120: 549–565.

Clements, T., John, A., Nielsen, K., An, D., Tan, S. & Milner-Gulland, E.J. 2010. Payments for biodiversity conservation in the context of weak institutions: Comparison of three programs from Cambodia. *Ecological Economics*, 69(6): 1283–1291.

Cooke, B., Langford, W.T., Gordon, A. & Bekessy, S. In review. Positioning ecological objectives in a social context: The design of private land conservation programs – a review. *Journal of Environmental Planning and Management*.

Daniels, A.E., Bagstad, K., Esposito, V., Moulaert, A. & Rodriguez, C.M. 2010. Understanding the impacts of Costa Rica's PES: Are we asking the right questions? *Ecological Economics*, 69(11): 2116–2126.

Ferraro, P.J. 2001. Global habitat protection: Limitations of development interventions and a role for conservation performance payments. *Conservation Biology*, 15(4): 990–1000.

Ferraro, P.J. & Pattanayak, S.K. 2006. Money for nothing? A call for empirical evaluation of biodiversity conservation investments. *PLOS Biology*, 4(4): 482–488.

Gill, N., Klepeis, P. & Chisholm, L. 2010. Stewardship among lifestyle oriented rural landowners. *Journal of Environmental Planning and Management*, 53(3): 317–334.

Gong, Y., Bull, G. & Baylis, K. 2010. Participation in the world's first Clean Development Mechanism forest project: The role of property rights, social capital and contractual rules. *Ecological Economics*, 69(6): 1292–1302.

Hatfield-Dodds, S. & Proctor, W. 2008. *Delivering on the promise of stewardship issues in realising the full potential of environmental stewardship payments for landholders and the land*. CSIRO Australia.

Kilgore, M.A., Greene, J.L., Jacobson, M.G., Straka, T.J. & Daniels, S.E. 2007. The influence of financial incentive programs in promoting sustainable forestry on the nation's family forests. *Journal of Forestry*, 4(8): 184–191.

Kosoy, N., Martineztuna, M., Muradian, R. & Martinezalier, J. 2007. Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America. *Ecological Economics*, 61(2–3): 446–455.

Lokhorst, A.M., van Dijk, J., Staats, H., van Dijk, E. & de Snoo, G. 2010. Using tailored information and public commitment to improve the environmental quality of farm lands: An example from the Netherlands. *Human Ecology: An Interdisciplinary Journal*, 38(1): 113–122.

McKenzie-Mohr, D. & Smith, W. 1999. *Fostering sustainable behavior: An introduction to community-based social marketing.* 2nd Edition. Gabriola Island, B.C., New Society.

Muradian, R., Corbera, E., Pascual, U., Kosoy, N. & May, P. H. 2010. Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services. *Ecological Economics*, 69(6): 1202–1208.

Murray, C., Sohngen, B. & Ross, M.T. 2007. Economic consequences of consideration of permanence, leakage and additionality for soil carbon sequestration projects. *Climate Change*, 80(1-2): 127–143.

OECD. 2010. *Paying for biodiversity: Enhancing the cost-effectiveness of payments for ecosystems services* (available at http://www.oecd.org/publishing/corrigenda).

Pannell, D., Marshall, G., Barr, N., Curtis, A., Vanclay, F. & Wilkinson, R. 2006. Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture*, 46(11): 1407–1424.

Petheram, L. & Campbell, B.M. 2010. Listening to locals on payments for environmental services. *Journal of Environmental Management*, 91(5): 1139–1149.

Polasky, S., Nelson E., Lonsdorf, E., Fackler, P. & Starfield, A. 2005. Conserving species in a working landscape: Land use with biological and economic objectives. *Ecological Applications*, 15: 1387–1401.

UNCTAD (United Nations Conference on Trade and Development). 2009. *World investment report: Transnational corporations, agricultural production and development, 2009* (available at http://unctad.org/docs/wir2009_en.pdf).

Van Hecken, G. & Bastiaensen, J. 2010. Payments for ecosystem services in Nicaragua: Do market-based approaches work? *Development and Change*, 41(3): 421–444.

Wendland, K. 2008. Rewards for ecosystem services and collective land tenure: Lessons from Ecuador and Indonesia. *Tenure Brief*, 9: 1–10.

Wilcove, D.S. & Lee, J. 2004. Using economic and regulatory incentives to restore endangered species: Lessons learned from three new programs. *Conservation Biology*, 18(3): 639–645.

Wunder, S., Engel, S. & Pagiola, S. 2008. Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. *Ecological Economics*, 65(4): 834–852.

PES FOR IMPROVED ECOSYSTEM WATER SERVICES IN PIMAMPIRO TOWN, ECUADOR

Sven Wunder
Centre for International Forest Research (CIFOR), Belém, Brazil

The Pimampiro PES Initiative was launched in the 2000, as part of the larger Nueva América forest project, an FAO-funded project for community forest management that worked with the Nueva América Association (ANA). Based on an interest in improving the water supply quality and quantity to the town of Pimampiro, this user-financed PES scheme has been as a result of direct negotiation between the municipality of Pimampiro and a couple of dozen farmer families upstream (members of the Nueva América Association), who have signed five-year contracts on an individual basis (IIED, 2007; Wunder and Albán, 2008).

The Nueva América forest, some 32 km from the town of Pimampiro, lies at between 2 900 and 3 950 metres above sea level, in the upper watershed of the Palahurcu River (Figure 22). Although the programme initially targeted 27 farming families owning a total area of 638 hectares, the programme had 19 families participating in 2007, representing 496 ha, or 77 percent of the total area.

The participating landowners agree to protect the native forest and Andean alpine grass (páramo) vegetation from deforestation and land conversion. A fund, the "Fondo para el pago por servicios ambientales para la protección y conservación de bosques y páramos con fines de regulación de agua" was initially established to finance the PES payments, with an investment of USD 15 000 from the Inter-American Foundation (USD 10 000), via CEDERENA (an NGO that evolved from the FAO-funded project) and the FAO-funded Community Forest Project (USD 5 000).

Jointly managed by CEDERENA and the municipality's newly-established environmental department (UMAT), this seed fund is pooled with money collected from the 20 percent increase in municipal water use charges.

The municipality collects an average of USD 1.20 per water-user family per month for the average use of 30 m^3 of water per month. Payments to landowners are made on a quarterly basis through the local offices of the Banco de Fomento. To receive payment, each landowner must sign a renewable five-year agreement with the municipality of Pimampiro.

Payment categories vary according to the condition of the ecosystem they agreed to protect, on a simple cost per land area model: USD 1.00/ha/month for undisturbed páramo or primary forest; USD 0.75 ha/month for old secondary forest; and USD 0.50 ha/month for new secondary forest.

One of the more interesting findings of this scheme has been that the 1 331 water users in the town agreed to pay more on their water bill for both watershed protection and improved infrastructure after a flooding event reduced running water to only two hours three days a week, thus alerting them about the risks to their water supply. While the impacts of the PES scheme have not been measured, hydrological modeling of the watershed showed that over the decade of duration it probably reduced sedimentation by more than 25 000 tonnes (affecting both water quality and damage risks to infrastructure), while dry-season flows were only marginally higher (0.5 percent) (Quintero *et al.*, 2009).

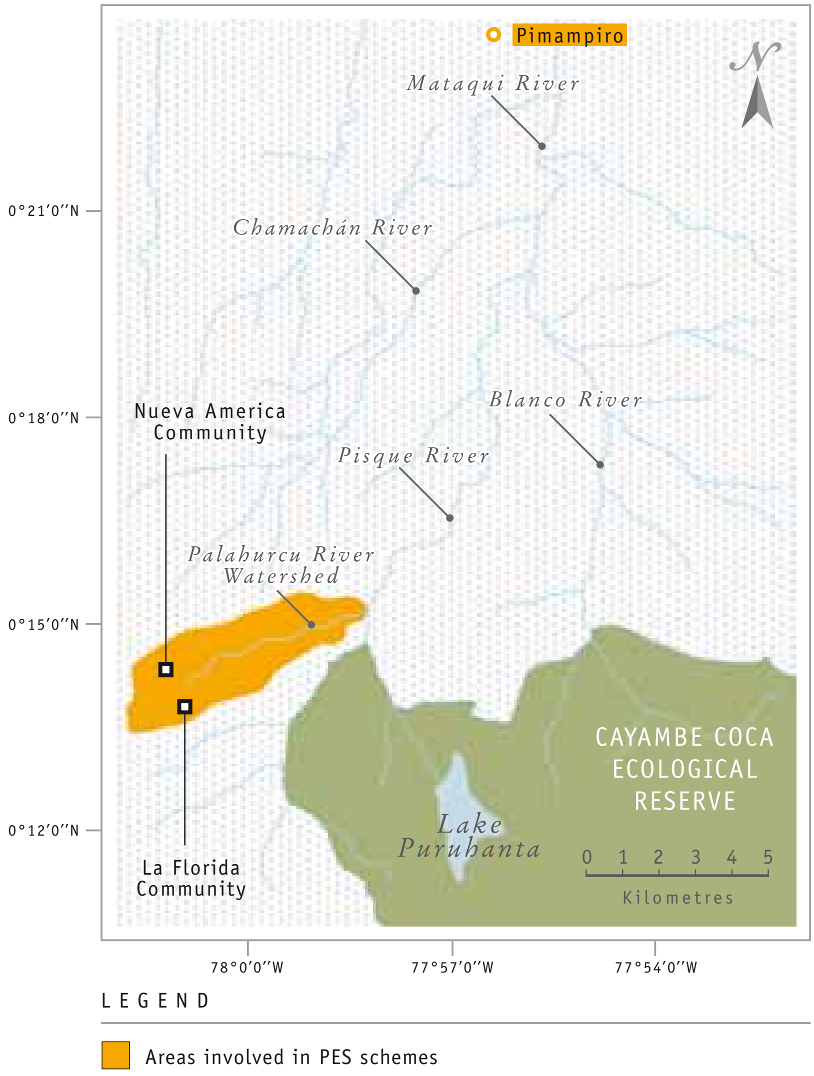
Participant farmers in the scheme receive an average of USD 21.10 per month, equivalent to about 30 percent of their monthly household expenditure and used to cover basic expenses and the families' short-term needs, such as food, agricultural production, health and education (Echavarría *et al.*, 2004).

Although the scheme has likely resulted in an ongoing significant improvement in water quality (and perhaps quantity) reaching the town, it is impossible to quantify deterministically just how much improvement has occurred. However, the scheme has seen a noticeable reduction in the frequency and intensity of encroachment on forest and páramo land, and monitoring by the municipal environmental department has demonstrated low levels of violations to the agreements in terms of slash-and-burn practices, unauthorised selective timber extraction, and soil and undergrowth extraction.

From an agricultural standpoint, as noted above, this scheme was also part of a larger sustainable development initiative in the area. Under this larger project, participants had the opportunity to access technical assistance and capacity building on agro-ecology (e.g. the creation of organic family gardens) and agroforestry projects (medicinal plants collection and commercialisation and the production of highly-valued ornamental plants, such as orchids).

Figure 22

Location of a key area within the catchment of the Palahurcu River for the maintenance of watershed services to the town of Pimampiro



Adapted from original map provided by Sven Wunder

Previous pages (from left to right):

↖ Pristine forests are increasingly logged by the Nueva America community that owns the upper Palahurcu watershed.

↖ Example of *páramo* vegetation, a neotropical ecosystem of high-altitude valleys and plains covered mainly by grasslands and sparse shrubs.

Current pages (from left to right):

→ The municipality of Pimampiro draws most of the water for its 13 000 inhabitants from the Palahurcu Watershed.

→ Water from the Palahurcu River is also used for irrigation.

REFERENCES

Echavarría, M., Vogel, J., Albán, M. & Meneses, F. 2004 The impacts of payments for watershed services in Ecuador. Emerging lessons from Pimampiro and Cuenca. Markets for Enviromental Services Series, No. 4. London, Environmental Economics Programme, IIED (also available at http://pubs.iied.org/pdfs/9285IIED.pdf).

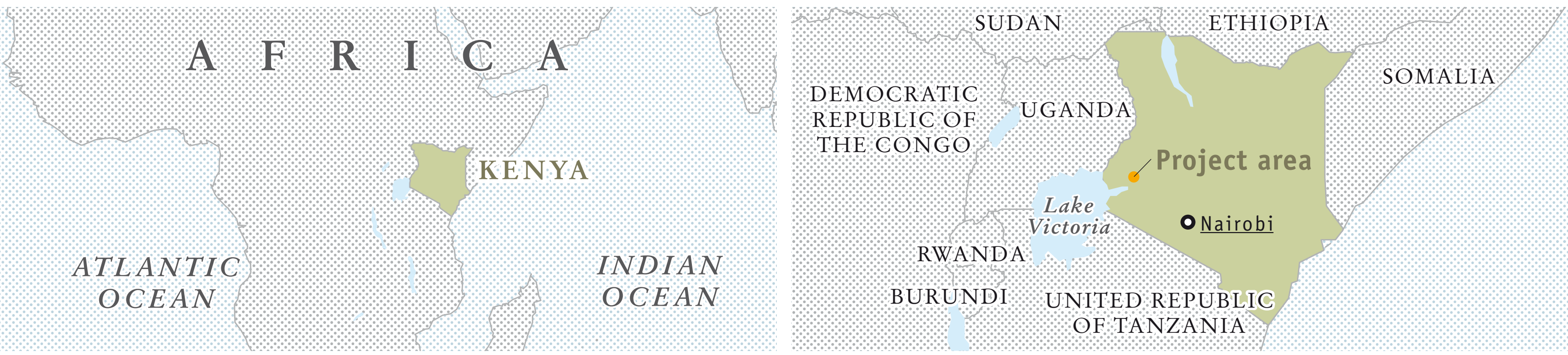
IIED (International Institute for Environment and Development). 2007. Ecuador – Pimampiro. Watershed markets: Case studies. London, IIED (also available at http://www.watershedmarkets.org/casestudies/Ecuador_Pimampiro_E.html).

Quintero, M., Wunder, S. & Estrada, R.D. 2009. For services rendered? Modeling hydrology and livelihoods in Andean payments for environmental services schemes. *Forest Ecology and Management*, 258:1871–1880.

Wunder, S. & Albán, M. 2008. Decentralized payments for environmental services: The cases of Pimampiro and PROFAFOR in Ecuador. *Ecological Economics*, 65(4): 685–698.

FARMER'S PREFERENCES AND PERSPECTIVES ON PLANTING ADDITIONAL TREES ON THEIR FARMS, LAKE VICTORIA BASIN, WESTERN KENYA

Rohit Jindal [1] *and Brent Swallow*[2]
[1]Michigan State University, East Lansing, Minnesota, USA
[2]University of Alberta, Edmonton, Canada



The World Agroforestry Centre (ICRAF) has been conducting research on land management in the Lake Victoria basin since 1999. Early research showed the nature and extent of land degradation, the potential for agroforestry to reduce land degradation and the links between land degradation and the pollution and eutrophication problems in Lake Victoria. That research also shows that sediments and nutrients from the Nyando and Yala basins aggravate the degraded ecological conditions of Lake Victoria, as well as the likelihood of a resurgence of water hyacinth (*Eichhornia crassipes*) invasion.

Water hyacinth, native to South America, was probably introduced to the lake in the 1980s from Rwanda via the Kagera River. In 1998, the free-floating perennial weed had covered a surface of 20 000 hectares, creating a thick mat that even prevented fishermen from launching their boats. This exotic floating vegetation has completely altered the native species composition of the lake, creating a proliferation of blue-green algae and record rates of fish species extinctions. In 2001, the invasion was controlled by the use of an Australian hyacinth-eating insect (the *Neochitina* weevil), but a resurgence of infestations was observed in 2006 and in the following years. Continuous sound management is needed today to contain the ecological and economic damage and loss.

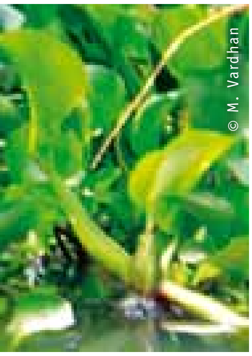
The Nyando and Yala watersheds each occupy about 3 500 km^2 and have a high population density, which in some areas can exceed 1 200 persons per km^2. During the last 30 years the drastic alteration of land cover caused by a high deforestation rate has significantly increased the level of runoff, especially in the extensively cultivated areas, which are located in the middle section of each of the two watersheds (Figure 23 and 24). The steep slopes that characterise both watersheds make them particularly vulnerable to soil erosion. The landscape, particularly in Nyando, is marked by erosion features, such as rills, badlands and gullies. Varying with the recorded precipitation rate (1999-2005) in Nyando, the sediment yield was estimated at between one and three million tonnes per year, while in Yala it was between two and three million tonnes per year.

The first phase of research on land degradation led to two follow-up studies. In 2007-2008, ICRAF conducted an integrated study of trends and trade-offs between ecosystem services in the Yala and Nyando River Basins. Since 2005, ICRAF and the Kenya Agricultural Research Institute (KARI), with funding from the World Bank, have been implementing the Western Kenya Integrated Ecosystem Project (WKIEP). The goal of WKIEP is to establish a mechanism that rewards farmers for undertaking agroforestry practices in the Nyando and Yala basins. It is hoped that appropriate agroforestry practices will help to restore highly degraded areas, enhancing carbon stocks and reducing erosion at the site level, while also reducing sedimentation at the watershed level. Within the WKIEP project a survey, led by R. Jindal at Michigan State University, was conducted amongst 277 farmers in the Nyando and Yala Watersheds in 2005. The aim of the survey was to investigate farmers' willingness to plant additional trees on their farms to reduce siltation and nitrogen and phosphorous in-flow into Lake Victoria coming from the two rivers.

The trade-off study shows that the mid-altitude parts of the Nyando Basin are increasingly cultivated with maize, which in 2006 already covered 93 percent of the total agricultural land and had replaced minor cereal and cash crops, such as millet, pyrethrum, potatoes, cassava, Napier grass and wheat. Tea plantations are also important high income crops that are often found close to the remaining forest patches in the upper sections of the watersheds. In particular, the Yala Basin has recorded a large increase in tea production from 2.9 percent of the area of the basin in 1997 to 5.3 percent in 2006. In the Yala basin, tea has replaced sugarcane plantations in some parts, a better crop than tea for erosion control. In the Nyando Basin, sugarcane still occupies the whole central-western part of the watershed.

Both the Nyando and Yala Rivers convey large water flows; river flooding is common and large swamps are found around their lower sections before flowing into Lake Victoria. In the Nyando Basin, from 1991 to 2006, natural wetlands decreased from 1.93 percent to 0.40 percent of the watershed area due to the increasing cultivation of rice and other irrigated crops.

The spatial analysis of the land use occurring in different sections of the two watersheds revealed that some areas are intensively cultivated with high productivity crops, mainly tea, but



Current pages (from left to right):

→ Water hyacinth (*Eichhornia crassipes*) is an exotic aquatic plant, accidentally introduced into the Lake Victoria, which has proliferated enormously, disrupting the main biological processes of the lake.

→ The thick mats created by the water hyacinth often represent a major problem for the launching of fishing boats.

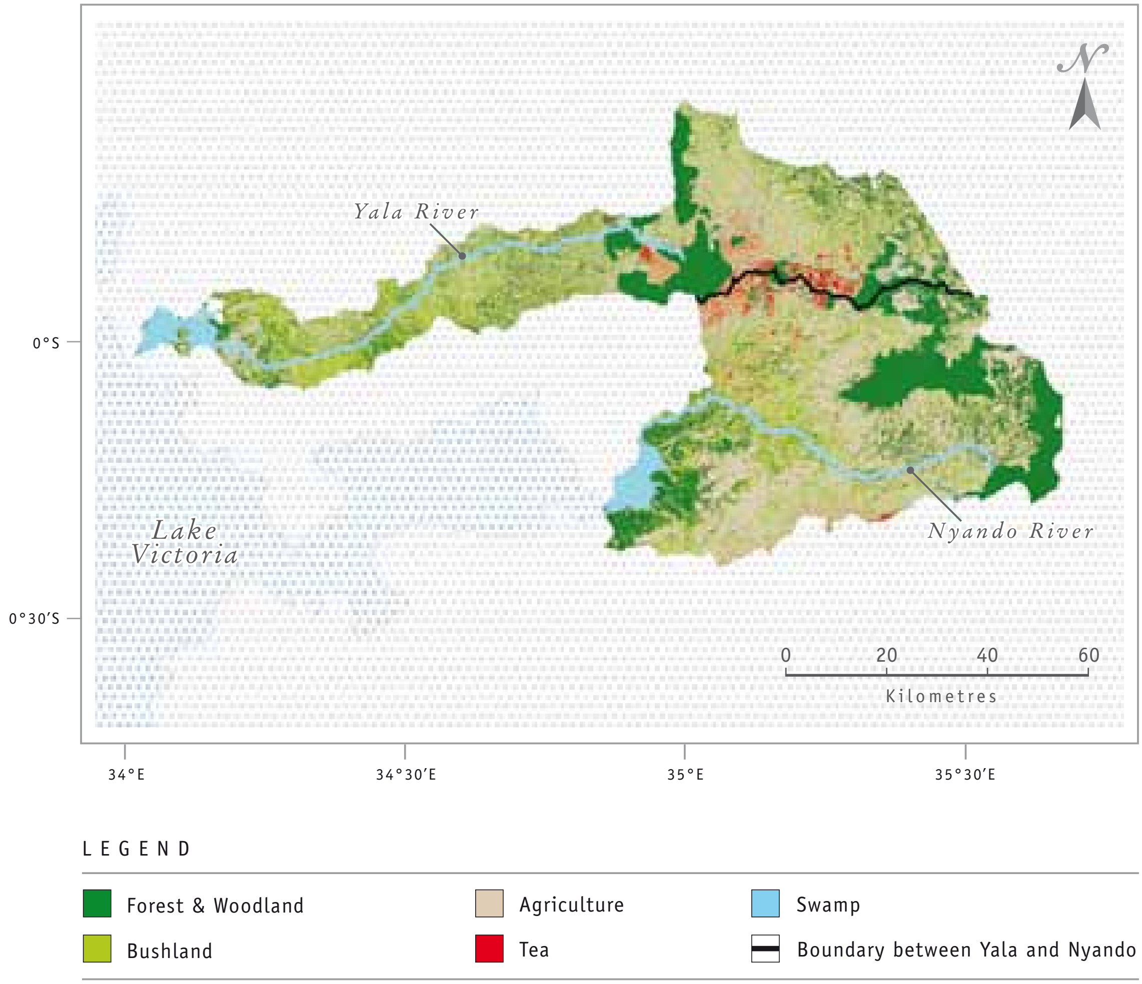
also coffee, fruit and woodlots. In these areas, the maximisation of provisioning services (i.e. cash crops) has resulted in a severe alteration of regulating services (i.e. erosion control). Other areas, mainly found in the low and mid-altitude zones of the two watersheds, are characterised by the same disruption of regulating services; however, in these areas, the decline in soil fertility caused by runoff cannot be handled due to the low household income and poor investment opportunities ('poverty traps').

Thus, the need to explore the potential of a PES scheme to provide incentives to develop agricultural practices aimed at coupling agricultural production and income generation with the restoration of regulating services in the Nyando and Yala watersheds was highlighted. In particular, a field survey carried out by the WKIEP project investigated farmers' attitudes and perspectives towards reforestation programmes. The two watersheds were sampled in randomly selected sub-locations. In each sub-location, the furthest point from the main road accessible by car was identified and from there three interviewers walked in opposing directions to interview the first five households encountered in each direction. The respondents (n=277) were asked to express their preferences on the number of seedlings and tree species they would be willing to plant under three different scenarios (note: payments would only be made six months after the seedlings were planted and on the basis of the actual number of surviving seedlings):

a. they would have to pay ten Kenyan shillings (Ksh.) per seedling
b. they would receive free seedlings
c. they would receive ten Kenyan shillings (Ksh.) per seedling

The results of the survey (Table 7) showed that if farmers had to buy seedlings, they were willing to plant an average of 44 seedlings per household (representing a type of baseline scenario). However, the number of planted trees would increase if the interviewed farmers received free seedlings or if they received direct incentives. Econometric techniques were used to control for the effect of some characteristics of the households and the analysis showed that farmers were willing to plant about 18 more trees for every Kenyan Shilling of direct payment made to them.

Figure 23
Land cover of the Nyando and Yala watersheds in 1973



Adapted from original map by Miika Mäkelä (ICRAF)

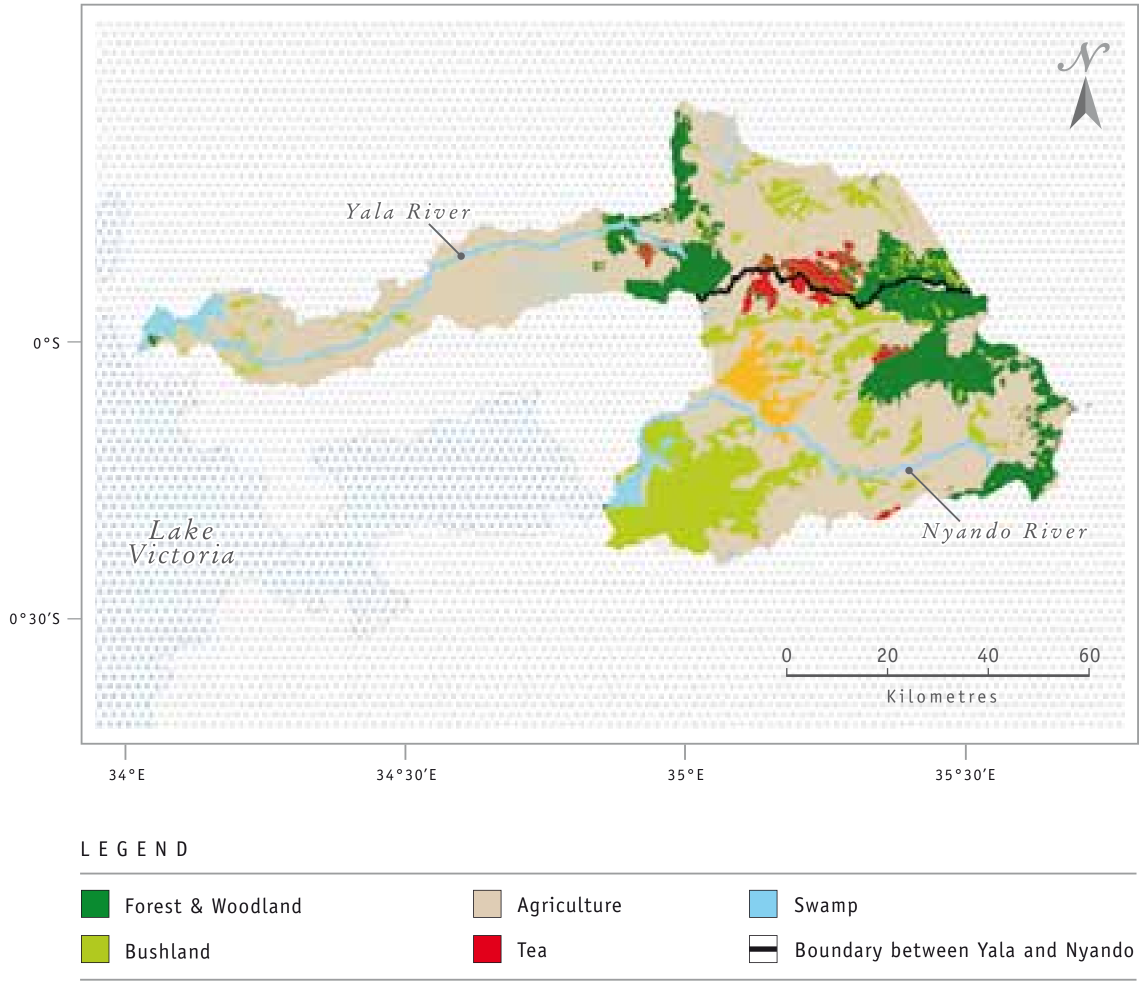
Current pages (from left to right):

→ Extreme soil erosion in the Lake Victoria Basin causes millions of tonnes of topsoil to be washed into the Nyando and Yala Rivers every year.

→ Poor soil conservation agricultural practices on steep slopes has led to accelerated rates of erosion.

→ Alteration of the geomorphology and gully erosion in the Nyando and Yala Watersheds is a clear sign of severe land degradation and disruption of many ecosystem functions in both watersheds.

Figure 24
Land cover of the Nyando and Yala watersheds in 2003



Adapted from original map by Miika Mäkelä (ICRAF)

Table 7

Preferences of the interviewed farmers on the number of seedlings and tree species to plant on their farms

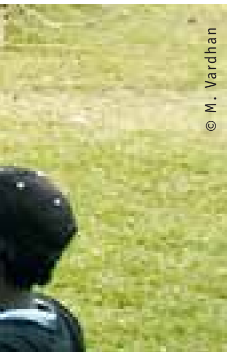
	Paying 10 Ksh. per seedling	Receiving free seedlings	Receiving 10 Ksh. per seedling
Mean number of seedling demanded	44	203	245
Standard deviation	116	426	494
% of respondents that chose at least one exotic timber species	62%	86%	82%

Note: Ksh. = Kenyan shillings
Source: Jindal, 2008

In particular, the willingness for planting trees was strongly influenced by: gender (males were willing to plant almost 100 more trees each than females), age (younger respondents were more likely to plant trees than older respondents), labour supply (each additional member with full-time involvement in agriculture was willing to plant an average of 21 trees per household) and secure land tenure (secure tenure determined an average increase of 50 trees per household).

A strong preference for timber species was recorded. In particular, males were more likely to prefer timber trees than females. According to an existing local custom, women belonging to the Luo tribe are not supposed to plant timber trees and are also restricted from visiting agricultural fields during certain times.

In choosing timber tree species, the majority of the interviewed farmers included at least one exotic timber species (*Eucalyptus* spp., *Casuarina equisetifolia* and *Gravellia pteridifolia*) under all presented scenarios. The choice of exotic species is probably linked to their fast growth rate from which farmers can expect higher returns.



© M. Vardhan

© M. Vardhan

Current pages (from left to right):

→ Focus group with women to understand their priorities regarding natural resource management in the Lake Victoria Basin.

→ Reforestation with native species is crucial to maintaining the functionality of ecosystems.

The exploratory findings of this study show that incentives in the form of a seedling subsidy can increase the likelihood of reforestation programmes. However, a well-designed PES scheme should always include ecological awareness and participatory consensus about the need to reforest with native tree species. In the Nyando and Yala Basins, an increased use of *Eucalyptus* trees, consequent to the government prohibition to log native forest species, has already been reported. Farmer preferences for exotic species is alarming considering the long-term ecological disaster associated with the use of exotic species on drylands and the already degraded ecological conditions of the Lake Victoria basin.

Usually, farmers' preferences are assessed through a contingent valuation method, in which respondents state the amount they would be willing to pay for a good, or the amount they would be willing to accept as a compensation for voluntarily giving up a good. An alternative approach is to assess farmers' preferences by asking respondents to choose between two versions of a rewarding scheme that differ by a certain attribute level. Offering farmers the choice between different scenarios can reveal important information about their preferences, their priorities and belief systems.

REFERENCES

Cheboiwo, J.K. & Langat, D. 2008. *Analysis of principles and potential partnerships for tree out-grower schemes in western Kenya*. Paper presented to the 4th KEFRI Scientific Conference, 6–9 October 2008, KEFRI, Muguga.

ICRAF. 2006. *Improved land management in the Lake Victoria basin: Final report on the TransVic project*. ICRAF Occasional Paper, No. 7

Jindal, R. 2008. *Exploring demand for forestry in Lake Victoria basin, Kenya: An econometric approach*. Paper presented at the Joint Annual Meeting of the Agricultural & Applied Economics Association and the Association of Environmental and Resource Economists, July 2008, Orlando, USA.

Swallow, B.M., Sang, J.K., Nyabenge, M., Bundotich, D.K., Duraiappah, A.K. & Yatich, T.B. 2009. Tradeoffs, synergies and traps among ecosystem services in the Lake Victoria basin of East Africa. *Environmental Science and Policy*, 12: 540–519.

.

CHAPTER 6

LANDSCAPE LABELLING APPROACHES TO PES: BUNDLING SERVICES, PRODUCTS AND STEWARDS

Jaboury Ghazoul[1], Claude Garcia[2] and Cheppudira Kushalappa[3]

[1] Institute of Terrestrial Ecosystems, Swiss Federal Institute of Technology Zurich (ETH), Zurich, Switzerland

[2] La recherche agronomique pour le développement (CIRAD), Montpellier, France

[3] College of Forestry, Ponnampet, India

ACKNOWLEDGEMENTS

This report is an expanded version of the paper by J. Ghazoul, C. Garcia and C.G. Kushalappa, 2009. "Landscape labelling: A concept for next-generation payment for ecosystem service schemes", published in *Forest Ecology and Management*, 258: 1889-1895.

CONTENTS

ABSTRACT

Landscape labelling is a new Payment for Ecosystem Services (PES) concept that seeks to combine elements of PES with product certification at a landscape scales. Landscape labelling proposes that managed rural landscapes which deliver valuable ecosystem services be awarded a 'landscape label', by which products derived from this landscape could be differentiated and value added, in the global market. A principal objective of landscape labelling is to deliver benefits to communities, rather than individual landowners, based on the continued delivery of ecosystem services as evaluated at landscape scales, rather than at the scale of private landholdings. In so doing, landscape labelling also seeks to overcome some of the existing challenges to the implementation of PES schemes, including evaluating opportunity costs and ecosystem service delivery, high transaction costs, difficulties in ensuring conditionality and limited inclusivity leading to inequitable distribution of benefits. The global export trade in many agricultural commodities derived from tropical smallholdings (including coffee, cacao and rubber) offers opportunities for the implementation of landscape labelling that is specifically targeted to benefit smallholders within a landscape mosaic. As such, landscape labelling would provide management with incentives to continue to meet the ecosystem service criteria required for certification. The label, with its associated conditionality criteria, could serve as a mechanism for securing additional payments for ecosystem services, which, under a landscape certification scheme, would be delivered to community-based organizations for investment in community and social projects that would benefit a far wider range of people than is possible in the current PES model.

INTRODUCTION

New approaches to the management of complex environmental problems have been conceptualised within the Millennium Ecosystem Assessment (MEA, 2005). The concept of ecosystems as providers of essential goods and services for the support of human well-being lies at the heart of the MEA. Ecosystem services are the multiple benefits that people receive from the natural environment and include: water purification and flood control by forests, carbon sequestration, pollination and prevention of soil erosion and sedimentation. Linking these ecosystem functions with human livelihood quality provides a basis for including conservation and environmentally-sensitive management in land-use decisions. How to successfully incorporate ecosystem service approaches within landscape management has yet to be clearly defined though. One promising approach is to pay

Linking ecosystem functions with human livelihood quality is key to ensuring sound land-use management landowners for the ecosystem services that their lands provide. Thus, Payment for Ecosystem Services (PES) schemes compensate (or reward) landowners for management that provides conservation or ecosystem service benefits to other parties, but which necessarily constrains their own revenue-generating opportunities. However, there remain a number of limitations that are common to most such approaches, principal among them being a clear definition of land-tenure, high establishment and transaction costs, low inclusivity of participation (and distribution of reward payments) and limited or uncertain ecosystem service provision. These problems have constrained the uptake of PES schemes and further undermined their potential in meeting poverty alleviation and development needs that are often concurrent with demands for habitat conservation.

In this chapter, a new concept for PES is proposed that seeks to overcome some of the problems associated with the current generation of PES schemes. This approach is called 'landscape labelling' and it extends existing PES ideas through their integration with the related concepts of product certification and which are applied collectively at a landscape scale, rather than the individual farm unit (Ghazoul *et al.*, 2009). This approach is described by highlighting its advantages over current systems, as well as its potential disadvantages that remain researchable challenges for its implementation. The idea is introduced to advance the debate on PES concepts in the hope that more effective ways of implementing PES concepts that achieve multiple benefits of conservation, ecosystem service provision and poverty alleviation can be realistically developed. As a concept, it is expected that landscape labelling will be challenged, refined and even ultimately rejected, in the hope that this process will accelerate the development of future PES schemes that are able to overcome many of the associated problems, as described below.

PES AND PRODUCT CERTIFICATION

PES rewards landowners for management activities that provide ecosystem services. Another market mechanism is that of product certification, which seeks to achieve environmental protection through market-based mechanisms, such as price premiums or improved market recognition. Both PES and certification provide financial incentives to landowners to manage their land such that environmental benefits are maintained (see also Chapter 1 "The role of PES in agriculture").

PES is essentially a voluntary transaction where an ecosystem service is purchased by a buyer from an ecosystem service provider (i.e. the seller). Current PES schemes require three steps: (a) an assessment of the range of ecosystem services generated in a particular area; (b) an estimate of the economic value of these benefits to different groups of people; and (c) the establishment of a regime or institution that is able to capture this value and reward landowners for preserving the delivery of the ecosystem services.

The development, application and acceptance of PES schemes face operational challenges at each of these steps, principally in the form of the evaluation of opportunity costs and ecosystem service delivery, high transaction costs and difficulties in ensuring conditionality (see also Chapter 4 "Cost-effective targeting of PES"). Overcoming these barriers is a precondition that can be facilitated by investing in ecological and economic valuation and by building community and institutional capacity. Even when these conditions are met, a PES scheme may ultimately be undermined by the failure to distribute benefits widely, leading to societal conflicts over land use (Pagiola *et al.*, 2007).

POVERTY ALLEVIATION AND EQUITY

The main objectives of PES are usually to secure environmental protection, but some have also been developed with the intention of alleviating poverty in rural areas. There are substantial challenges to the alleviation of poverty through PES-type approaches (Grieg-Gran *et al.*, 2005; Pagiola *et al.*, 2008; Wunder, 2008). At present, the beneficiaries of payments derived from most PES schemes are landowners who can enter into contractual agreements with institutions making the payments (companies, government agencies, NGOs, etc.). In this respect, PES schemes are often inappropriate mechanisms for poverty alleviation because they exclude the landless (i.e. those who tend to be the poorest of the poor). PES schemes often also exclude smallholders due to high transaction costs, uncertainty of formal land titles and their limited impact on ecosystem services (Engel *et al.*, 2008; Grieg-Gran *et al.*, 2005; Pagiola *et al.*, 2008; Wunder, 2008).

PES schemes are often inappropriate mechanisms for poverty alleviation because they exclude the landless

Consequently, land-based criteria for participation in PES could exclude billions of poor people worldwide. Out of necessity, the landless poor are often the agents of environmental degradation; thus, they are not only excluded from benefiting from PES schemes, but they are also placed in direct conflict with landowners who will seek to retain any financial rewards they enjoy under PES, which requires maintaining landscape quality for the continued delivery of ecosystem services. Implementation of most PES schemes is, therefore, strongly targeted and exclusionary (Wunder, 2008).

Transaction costs are often the biggest single barrier to participation of the poor in PES schemes (Smith and Scherr, 2002; Wunder and Albán, 2008). High transactions costs limit uptake to large landowners and exclude smallholders (Wunder and Albán, 2008). Buyers of ecosystem services are also disinclined to incur the costs of negotiating with many individual smallholders and, therefore, may specifically exclude small farmers from participation (Wunder and Albán, 2008).

It is also far from clear whether tropical rural communities, be they poor or otherwise, actually wish to engage in such schemes or not (Ghazoul, 2007a, 2007b, 2007c). PES must cover the opportunity costs of participation, which extend beyond income to encompass broader assessment of livelihood benefits and risks (Benitez *et al.*, 2006; Ghazoul, 2007a, 2007c; Wunder, 2008). Opportunity costs may be high or at least perceived to be so, particularly given increasing agricultural commodity prices linked with high demands for food and biofuels (Koh and Ghazoul, 2008). Problems associated with insecure land tenure and suspicion of outside agencies that offer contracts in return for restricting land-use options are further barriers to participation (Pagiola *et al.*, 2007).

VERIFICATION

Ultimately, the success of PES schemes rests on their ability to deliver what they promise to the buyers of the services. Implementing conditionality may represent a substantial proportion of the costs associated with PES and may also exceed local community capacities. Furthermore, the reliability of poor farmers as service suppliers may be low if they are unable to exclude outside factors. This is particularly likely when tenure rights are complex or uncertain, as is the case for many community-managed forested lands in India. Even if the delivery of services from the relevant landholdings is confirmed, the former pressure on the services may simply be displaced elsewhere (i.e. leakage) (Wunder and Albán, 2008). An alternative to quantified guarantees of ecosystem service provision is the use of proxies of service functions, such as land cover attributes (as has been adopted by the watershed protection model in Pimampiro, Ecuador) (Wunder and Albán, 2008), although such proxies must obviously be based on scientific justification of the validity of the proxies themselves (see also Chapter 3 "Opportunities and gaps in PES implementation and key areas for further investigation"). The advent of high resolution and relatively inexpensive remote sensing technologies, coupled with the spread of computer technology and internet access even to remote parts of the developing world, particularly India, provides considerable opportunities for the development of proxies for ecosystem services at the landscape scale.

LANDSCAPE LABELLING

The scientific community is grappling with the challenges of developing locally equitable, cost-efficient and trustworthy PES schemes. A new PES-type approach, called 'landscape labelling', has the potential to overcome many of these challenges by:

- Combining PES with certification of products derived from landscapes that demonstrably deliver benefits through ecosystem services;

- Delivering the benefits of PES schemes to all stakeholders contributing to a successful certification process through social and infrastructural investments;
- Making available an easily accessible format at the national and international level by which relevant information on ecosystem service provision (represented by a 'landscape label') can be verified.

Before elaborating on this concept further, it should be noted that landscapes cannot be objectively defined *a priori* as a geographic area with hard boundaries because human-dominated landscapes include not only the biophysical components of a geographical area, but also social, political and psychological components of that system (Aldrich and Sayer, 2007). In the context of landscape labelling, the 'landscape' is determined through agreements among and by the participation of local communities who then define the area encompassed within a landscape label scheme and, hence, the spatial extent of the landscape itself. What constitutes a community also requires definition, although this can only be done once the context is understood. Nevertheless, the landscape scale, as interpreted here, envisages that several communities would be encompassed, though these communities would share a sense of 'belonging' to the landscape as they define it. In summary, a landscape entering a landscape labelling scheme would be defined by geographic, cultural and social boundaries.

A landscape label can be the conduit for payments to be made to community-based organizations for ongoing compliance

It is proposed that managed rural landscapes recognised to be delivering ecosystem services (against relevant criteria and based on local and regional evaluation by appropriate institutions) should be acknowledged as such by granting the use of an exclusive 'landscape label' that is applicable across the whole landscape. A landscape label would represent the delivery of various ecosystem services and, thus, be the conduit through which payments for ecosystem services are made to appropriate community-based organizations to ensure the continued delivery of these services. The landscape label could also be used to identify a good as originating from an ecosystem service-providing region, as well as serving to symbolise the wide variety of ecosystem services provided by the landscape. A landscape label could also represent and indeed publicise the cultural and symbolic attributes of the landscape, as defined by local communities, thereby helping to define its heritage value and uniqueness for people beyond the landscape. This, in turn, would provide greater recognition to communities and help to empower them in negotiations with outside agencies (including government or companies) and also promote landscape recognition that could serve to generate new livelihood opportunities through, for example, tourism (Garcia *et al.*, 2007).

A landscape labelling approach, therefore, provides a mechanism by which payments for ecosystem services are delivered to the community on the basis of effective landscape management, while individual landowners and producers additionally benefit from the raised market recognition of their products through the use of the landscape label as a certificate of good land and environmental management. Thus, a landscape label potentially permits producer communities to improve market recognition, secure premium payments, gain access to niche markets and attain market benefits for minor products by association through the label with more commercially important products. The derived benefits can, in turn, secure an incentive for managing the landscape in such a way as to continue to meet the ecosystem service criteria required for certification. Landscape labelling has many other benefits in terms of reducing transaction costs, improving inclusivity and equity, more cost-effective assessments of conditionality, allowing more flexibility in response to changing market environments and providing social pressure to limit free-riding. It also has several potential problems though, which will be explained further below.

Landscape labels potentially permit producer communities to access new and more lucrative markets for products and services

Exploring the feasibility of the proposed landscape labelling scheme and the plausibility of the expectations outlined above assumes that ecological, social and economic knowledge can be properly integrated, that appropriate community-based institutions are established, and methods for easy and rapid verification of ecosystem service delivery and conditionality criteria are developed. Each of these issues is explored in detail later in this chapter, but first concepts that are somewhat related to the landscape labelling approach but fall short of its whole vision are described.

PRECURSORS TO LANDSCAPE LABELLING

The concept of landscape labelling has been preceded by other approaches that also seek to raise recognition of products, services and values generated by landscapes and thereby provide pathways for improved economic well-being of landscape inhabitants. Three such approaches are described below and the similarities and limitations of such approaches compared to landscape labelling are outlined. Firstly, ICRAF's *Rewarding Upland Poor for Environmental Services* (RUPES)[1] initiative is explored, which seeks to make PES schemes available to poor smallholders that are often excluded from PES schemes through a lack of capital, knowledge or insufficient land. Then, Geographic Indications are discussed, used to differentiate specific types of product from similar competitors with which they might be confused. RUPES is most closely associated with PES, while Geographical Indications (GI) is more akin to certification; while both have

1 http://rupes.worldagroforestry.org

similarities to landscape labelling, neither go as far as landscape labelling in what they seek to achieve. The Biosphere Reserve concept is the most closely aligned to landscape labelling, but again differs in a number of important respects.

Community-based PES

Reward schemes based on payments for ecosystem services that target poor smallholders do exist, as exemplified by ICRAF's two initiatives: *Rewarding Upland Poor for Environmental Services* (RUPES) programme and the similar *Pro-poor Rewards for Environmental Services in Africa* (PRESA) (ICRAF, 2008). Both RUPES and PRESA highlight social mobilisation, which represents community-based action to socially and politically empower communities to engage in PES schemes. Community-based institutions should, therefore, include accountability of local representation for decision making and conflict management. This requires that these organizations are sensitive to gender issues and represent the interests of the poorest members of society, as well as being able to reach agreement and consensus over issues of conflict. RUPES experience in the Kulekhani watershed (Nepal) has shown that the likelihood of achieving broadly acceptable PES systems for smallholders depends on shared perceptions of ecosystem services and opportunity costs, on representative community institutions that manage the implementation of PES scheme and trust between communities, regional and national governments and external actors as a basic condition for negotiated agreements. Indeed, conflict between local political parties is the main reason for the current delays in the selection and funding of PES-funded projects (see Case Study 9 "A community-based PES scheme for forest preservation and sediment control in Kulekhani, Nepal"). Similar to these schemes is the Mexican *Payments for Hydrological Environmental Services Program* (PEHS) (Muñoz-Piña *et al.*, 2008), but this differs from RUPES in that it targets legal landholders who, while undoubtedly poor, are still better off than the many smallholders with uncertain tenure or the landless poor.

Geographical Indications

A Geographical Indication (GI) identifies a good as originating in the territory, a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin. It serves as a marketing tool, adding value to agricultural products creating a unique identity for the products, based on the locality where they originate from and acknowledging the role of specific knowledge and natural resources of the production process (Addor and Grazioli, 2002).

GI was initially developed in early 20th-century Europe to protect consumers by offering reliable information about the goods they buy. It was thought that GI could also afford protection to producers, by fighting against reputation theft and unfair competition. A second generation of GI was extended to foster rural development by maintaining economic opportunities in rural areas (see Case Study 2 “Geographical indication (GI) certification in Ukraine”). The third and present incarnation of the GI, as adopted and adapted by several developing countries, including India, has extended the concept to the environment and the cultural and biological diversity associated with local production (Bérard and Marchenay, 2006; Garcia *et al.*, 2007). With GI protection, producers are able to command premiums for their products, especially if perceived and/or actual quality differences exist, including product differences attributable to their unique geographical origin, as opposed to varietal origins (Agarwal and Barone, 2005).

Each of these schemes presents some advantages over existing systems in terms of delivering benefits to a wider range of ecosystem providers and providing new opportunities through improved product and product locality recognition. Each, however, retains some of the problems commonly associated with PES. GI is simply a certification scheme that certifies producers of specific goods from locations that give reputation to the product and, therefore, excludes landless or smallholders who are unable to overcome the transaction and investment costs to participate. GI also differs from landscape labelling in that it offers no payment for any ecosystem services. RUPES seeks to overcome such problems by offering PES schemes to aggregated smallholders, but landless poor often gain no benefit (although see the specific case of Kulekhani, Nepal) and smallholders remain entirely dependent on ecosystem service buyers as they gain no additional recognition for their agricultural products though their participation.

Biosphere Reserves

The United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserves combine a core protected area with zones where sustainable development is fostered by local individuals and enterprises. A certification scheme backed by UNESCO confers international visibility (UNESCO, 2008). Designation of a locality as a Biosphere Reserve by UNESCO raises awareness among local people, other citizens and government authorities of the value of the landscape for nature conservation and sustainable development. The biosphere label is often also used to market a variety of goods produced within Biosphere Reserves, though this is not linked to any verified environmental criteria. Rather, the UNESCO biosphere label is used more similarly to that of a GI, though rather than being product specific, it can instead be adopted by almost any product marketed as emanating from the Biosphere Reserve (an example of this would be cheese from the Entlebuch Biosphere Reserve in Switzerland). In this way, the biosphere label provides publicity for the biosphere region and can be used to promote the products emanating from it. Because the label raises the profile of the region and its landscape as a whole, it therefore stands to benefit many producers living in the Biosphere Reserve, as well as other types of business, such as tourism. There are, however, no coherent mechanisms for payments to be made to the community for specific ecosystem services. Thus, Biosphere Reserves provide benefits through increased recognition of products and product locality. They are not directly or verifiably linked to assessments of the ecosystem services provided by the landscape though; however, it is implicit in the designation that landscape environmental quality is high.

THE ADDITIONALITY OF LANDSCAPE LABELLING

Landscape labelling borrows ideas from each of these approaches and combines them with new ideas into a single approach. This approach has many of the advantages of the above-mentioned schemes, as well as several additional advantages, but also inevitably has some associated disadvantages or obstacles that will remain challenging for its implementation. To assess the potential of landscape labelling, its features will be explored in more detail. In this respect, eight features that are believed to be advantages over existing PES systems are examined below.

Inclusivity and equitable distribution of benefits and poverty alleviation

A major constraint of current forms of PES is that they are generally limited to large landowners who can provide quantifiable and verifiable services and who can overcome the transaction costs of participation. This excludes landless people and smallholders for whom participation is not possible due to lack of capacity or because they are specifically excluded due to insufficient land size. For example, the Ecuadorian PROFAFOR[2] scheme operates only with landowners that have a minimum of 50 hectares (Wunder and Albán, 2008). This can lead to problems in that the PES may become a source of conflict between landowners and the landless. This can arise in several ways (see also Chapter 5 “Social and cultural drivers behind the success of PES”).

To secure PES payments, landowners may exclude the landless from extracting resources from areas that were previously accessible to them. This could lead to leakage in that resource users may be forced to extract the resources elsewhere in the landscape. A landscape approach will help to detect and prevent leakage from within the boundaries of the landscape, but not necessarily beyond its boundaries.

2 http://www.profafor.com

Landscape labelling provides a label that signifies effective ecosystem service provision by a landscape, rather than by a single farm and implicitly recognises that landscape structure is a function of management and use by all community members (see also Chapter 3 “Opportunities and gaps in PES implementation and key areas for further investigation”). It is on this basis that payments are made by ecosystem service buyers to community-based organizations. These payments are invested into social and community projects or initiatives. Thus, landscape labelling provides the potential to secure benefits to all community members including the landless poor. While these benefits are indirect, they may be important in providing improved access to markets, better education and healthcare, micro-insurance, etc. (Table 8).

Landscape labelling is also inclusive in that the use of a landscape label is not restricted to a particular product, as is the case with GI, but associated with the wider landscape. Hence, any product that is derived from that landscape can use the label to signify that it has been produced under a management system that continues to provide ecosystem services. This provides benefits in terms of market recognition and potentially also price premiums to all farmers regardless of the type of product they are producing. Indeed, the concept may be advanced further by extending a label to non-agricultural products, such as artisanal commodities or other small industries. Theoretically, provided the landscape as a whole continues to deliver ecosystem services according to the criteria by which the landscape label was awarded, there is no reason why a label could not be used by any kind of industry within the locality. This may even allow environmentally-damaging industries to continue their activities, thereby resolving any conflicts that might otherwise arise, provided that their further expansion does not undermine the validity of the landscape label according to the criteria by which it was granted.

Transaction costs

As noted previously, transaction costs may seriously limit the uptake of PES. Transaction costs are particularly important for ecosystem services that can be independently and unambiguously delivered and quantified by many discrete landowners (e.g. carbon sequestration). Watershed, landscape beauty and biodiversity services can be more easily adapted to smallholder participation because the service buyer is forced to engage with collectives of smallholders at a much larger scales (Wunder, 2008; Wunder and Albán, 2008). Negotiation with many such smallholders clearly incurs high costs; the success of the RUPES scheme is in its ability to engage individuals though collective action (see also Chapter 4 “Cost-effective targeting of PES”).

Landscape labelling differs from RUPES and other PES schemes in that contracts are negotiated with representative community organizations, rather than individuals, and verification is based on landscape scales, rather than on individual farm units. It is expected that this will reduce considerably the number of interactions and, therefore, the costs, although it is possible that costs will simply be displaced to the community institutions, which would incur the costs of negotiating among their members regarding participation in the landscape labelling scheme.

Bundled service provision

The opportunity of a landscape approach allows the local communities, buyers of ecosystem services (at a range of scales), conservationists and others to identify and value a wide variety of services and landscape values concurrently. Once identified, the variety of services can then be incorporated into management. This contrasts with current buyers of ecosystem services who often target one or a limited number of services (e.g. carbon sequestration, water provision, etc.) within a landscape, leading to potential trade-offs with other services that are either not recognised or are undervalued. Landscape labelling allows for a wide variety of services to be recognised and maintained across the landscape, depending on local, national and international demands.

Landscape labelling also has great potential for bundling several ecosystem services together across the landscape

In addition, current PES schemes do not distinguish the appropriateness of land for particular service provision. Thus, planting trees may provide soil preservation services in some locations, but may be inappropriate in wetlands that regulate water flows. Through community participation, an integral part of landscape labelling and the flexibility afforded by a landscape approach, a wide range of ecosystem services can be incorporated into management that takes account of the appropriate distribution of service-providing habitats.

Conditionality

The success of a product certificate is dependent on the trust that consumers place in what the certificate represents. If forest cover is accepted as an appropriate proxy for ecosystem service delivery, then as a coarse measure of the certificate's validity an opportunity for self verification is provided by widely available software, such as Google Earth™. Thus, remote sensing that provides information on changes in land cover distribution could be made readily accessible through existing technologies and platforms, by which consumers can verify the veracity of any landscape label, at least in coarse terms. Such platforms could also raise awareness of the region in general, with further knock-on benefits to producer communities.

Nevertheless, ensuring adherence to landscape labelling requirements is likely to be complex, necessitating interaction and agreement between many individuals, villages and community-based institutions. This represents another way in which transaction costs may be shifted from the buyers of services (who would otherwise have had to verify service provision by individual landowners according to specific contractual obligations) to the sellers, in the form of community organizations. Verification by buyers needs be little more than an analysis of remote sensing images at appropriate time intervals with occasional ground-truthing, while it remains up to the communities to ensure that obligations are being met and conflicts associated with such obligations are appropriately managed.

Market recognition

A landscape label provides clear recognition of not just the landscape, which would itself be beneficial for promoting tourism and other income generating opportunities, but also in improving product recognition in the regional, national and global markets. This offers opportunities for increasing market share and differentiating products from competitors; it also allows for minor products to benefit by association with commercially important products that use the same label. Landscape labels, therefore, need not deliver price premiums to be beneficial, but simply provide uniform market recognition for a wide range of products.

Community management and social pressure

The success of community-wide schemes is dependent on effective institutional structures that provide appropriate negotiation and communication pathways among the variety of community organizations. A diversity of community-based organizations and interests is typical of many rural landscapes and ensuring effective interaction among such organizations is one of the most serious challenges to the implementation of landscape-level PES processes.

Indeed, the success of the landscape labelling approach rests on the effective functioning of such organizations, as well as cooperation between them. Payments to support a certified landscape are expected to be made to appropriate community institutions that will be responsible for making investment decisions. Conflicts between community-based organizations and corruption within them are perhaps the most important threats to the successful implementation of landscape labelling. Nevertheless, there is considerable awareness and knowledge regarding empowerment of and collaboration among community-based organizations and examples of collaborative networks to secure wider community benefits are known. These include the Model Forest Trust system, which in the district of Kodagu has been developed into a network of stakeholders that share

The success of landscape labelling depends on cooperation between several community-based organizations within a given landscape the common goal of sustainable landscape and forest management with a view to preserving ecosystem services and local livelihoods (see Case Study 8 "Geographical Indications and landscape labelling in Kodagu district, India").

Flexibility in decision making

Another limitation of PES is that landowners are contractually bound to restrict their activities on their land and are, therefore, limited in the extent to which they can respond to changing commodity markets. This restriction of their management choices makes landowners somewhat wary of PES. However, assessing ecosystem service provision at the aggregated scale of the landscape allows greater flexibility regarding land-use decisions and allows for development when opportunity costs at a particular location are high, so long as this development is offset elsewhere within the landscape. This raises the potential for a landscape-wide offset market, permitting landowners to offset certain environmentally-damaging activities and thereby retain the benefits of landscape labelling. Such flexibility is likely to make landscape labelling more attractive to wide participation, as there is the recognition that high opportunity costs can be accommodated through reforestation or improved forest protection elsewhere within the landscape where opportunity costs are lower. This presupposes that ecosystem services continue to be successfully provided to the standard which is required to maintain justification for the associated payments. This is the nub of conditionality, which is itself a prerequisite for a successful PES scheme. Thus, offsetting is more likely to work if there is appropriate planning about where development might take place such that impacts are minimised and where restoration for offsetting should be implemented to maximise resulting ecosystem service benefits. This will undoubtedly raise the costs of implementation and the actual degree of flexibility afforded by offsetting will be shaped by these considerations.

Assessing ecosystem services at the aggregated landscape scale allows greater flexibility in land-use decisions at the farm level

Inclusion of non-market values and local community perceptions

It is possible that a landscape label could represent more than just goods and services that have market value, but also non-market values, including the cultural and spiritual importance of landscape features, as well as natural heritage, notably biodiversity. Many tropical landscapes are rich in biodiversity that has little direct economic value or may harbour species that have local religious or spiritual symbolism, but little significance for buyers of ecosystem services.

Additionally, to avoid conflicts among landowners and the landless it is important that landscape labelling recognises local values and local use of habitats (see also Chapter 3 "Opportunities and gaps in PES implementation and key areas for further investigation"). If such values are incorporated in a landscape labelling approach, it can then serve to minimise or avoid conflicts between landowners seeking to protect their forest under landscape labelling conditions and the landless who extract resources from such habitats.

BARRIERS TO THE UPTAKE OF LANDSCAPE LABELLING

Barriers to the adoption of landscape labels may also include a lack of awareness among the farmers about the concept of labelling or ecosystem services provided by the landscape. Producers may also not appreciate the importance of PES conditionality, i.e. the need to maintain service provision to continue receiving PES payments and to justify an associated landscape label. Such barriers, however, are common to all PES schemes.

There remain several unresolved, or at least poorly resolved, concerns with regard to landscape labelling specifically, including dealing with 'free-riders', managing conditionality, avoiding leakage, ensuring effective functioning of community institutions and dealing with disturbances beyond the control of the communities (e.g. atmospheric pollution, climate change). Community relations (e.g. between producers and other community groups) may become strained as any PES necessarily restricts the range of livelihood options available to producers. The linking of a PES (that benefits the farmer) to a certificate (that benefits the wider community) could improve such relations by ensuring that the two groups have common goals. Peer pressure may act to minimise free-riding, but may also create and exacerbate conflicts. Opt-out agreements for individual landowners allow for flexibility in decision making, but may erode the landscape labelling concept if too much flexibility is allowed. Leakage is less likely in a landscape labelling approach because the assessment for the delivery of services is made at the scale of the entire landscape, although this would not account for displacement beyond the boundaries of the landscape.

The landscape labelling approach has yet to fully deal with a number of key aspects before it can be adopted at a wider scale

Another important issue that needs further consideration is the decisions that should be taken by buyers for ecosystem services under conditions of non-compliance. When ecosystem service provision is attributed not to a single individual, but to the entire community, then in the event that ecosystem services fail to be delivered the expected course of action would be to reduce or stop payments. This raises important concerns regarding the morality of such an interruption in that the landscape labelling payments could be providing widespread community benefits, including poverty alleviation.

Although not all these issues can be addressed in detail within the scope of this paper, nor is it clear how they should be addressed, it is hoped that the description of the concept generates discussion that will lead to the development of improved PES systems that provide the advantages listed above without, ultimately, the disadvantages that are readily recognised.

The landscape labelling concept differs from other PES approaches in that it specifies a landscape-wide PES scheme and invests funds into community-based projects that have the potential to benefit a far greater number of people than might otherwise be the case, yet also allows for additional benefits to landowners through product differentiation. Payments made to community-based institutions to support community projects (e.g. micro-insurance, micro-credit, education and health infrastructure, improved transportation and communication networks, etc.) benefit a much wider range of community members, regardless of societal status and instigate social pressure acting against free-riders. Additionally, by building capacity among community-based networks (such as in the Kodagu Model Forest Trust) and, ultimately, by raising awareness of the landscape in the wider social and political environment, it offers possibilities to improve communities' abilities to achieve official recognition of traditional management practices and land rights. There are clear benefits over existing PES schemes and yet there are also major obstacles to be investigated and overcome if landscape labelling is to make a useful contribution in real terms. Through this paper it is hoped that new ideas could be generated and a discussion fostered by which PES approaches overall can be advanced and improved.

Table 8

Comparison of current PES concepts with landscape labelling

PES (*sensu* Wunder, 2005)	Landscape labelling
Moderate establishment costs	High establishment costs
High transaction costs borne by participating individuals	Low transaction costs (although high transaction costs may be deferred to community-level organizations)
Low equity (participation in PES usually limited to large landowners)	High equity (allows participation by all community members)
Voluntary at individual level	Voluntary at community level (individual non-participants effectively become free-riders)
Environmental quality managed by individual landowner (possibly leading to exclusion of other resource users)	Environmental quality managed by landowners and community members and mediated through community-based organizations
Service provision at farm scale (aggregated units may be insufficient to provide large-scale ecosystem services)	Service provision at the landscape scale (encompassing all ecosystem services provided by the landscape)
Relatively few services provided	Relatively many services provided
Little flexibility in land use at farm scale (individuals contractually bound to limited land uses)	Large flexibility in land use at farm scale, provided criteria are met at the landscape scale
Conditionality verified at farm scale	Conditionality verified at landscape scale through combination of remote sensing and ground-truthing
Financial reward paid directly to landowner (limited distribution of PES benefits)	Financial rewards realized through a variety of mechanisms, but mainly through community-based institutions for social projects (wide distribution of PES benefits)
Little potential for poverty alleviation	Large potential for poverty alleviation
Values limited to interests of ES buyers	Potential to encompass many landscape and environmental values, including cultural and symbolic features
Independent of community-based institutions	Very dependent on effectively functioning community-based institutions
Financial rewards received for provision of ecosystem services only	Financial rewards received for ecosystem services and potentially through product certification
Little potential for wider landscape recognition	Large potential for wider landscape recognition
Top-down enforcement of individual contractual obligations	Bottom-up (peer pressure) and top-down (ES buyer pressure) enforcement of community contractual obligations
Entirely dependent on buyers of ES for funding	Certification offers some independence from ES buyers
Clear boundary definition	Landscape boundary definition requires negotiation and agreement

REFERENCES

Addor, F. & Grazioli, A. 2002. Geographical Indications beyond wines and spirits: A roadmap for a better protection for Geographical Indications in the WTO/TRIPS Agreement. *The Journal of World Intellectual Property*, 5: 865–897.

Agarwal S. & Barone M.J. 2005. *Emerging issues for geographical indication branding strategies*. MATRIC Research Paper, No. 05-MRP 9. Midwest Agribusiness Trade Research and Information Centre, Iowa State University (available at http://www.card.iastate.edu/publications/DBS/PDFFiles/05mrp9.pdf).

Aldrich, M. & Sayer, J. 2007. *Landscape outcomes assessment methodology*. WWF Forests for Life Programme. May 2007.

Benitez, P.C., Kuosmanen, T., Olschewski, R. & van Kooten, G.C. 2006. Conservation payments under risk: A stochastic dominance approach. *American Journal of Agricultural Economics*, 88: 1–15.

Bérard, L. & Marchenay, P. 2006. Local products and Geographical Indications: Taking account of local knowledge and biodiversity. *International Social Science Journal*, 58: 109–116.

Engel, S., Pagiola, S. & Wunder, S. 2008. Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics*, 65: 663–674.

Garcia, C., Marie-Vivien, D., Kushalappa, C.G., Chengappa, P.G. & Nanaya, K.M. 2007. Geographical Indications and biodiversity in the Western Ghats, India. *Mountain Research and Development*, 27(3): 206–210.

Ghazoul, J. 2007a. Challenges to the uptake of the ecosystem service rationale for conservation. *Conservation Biology*, 21: 1651–1652.

Ghazoul, J. 2007b. Placing humans at the heart of conservation. *Biotropica*, 39: 565–566.

Ghazoul, J. 2007c. Recognizing the complexities of ecosystem management and the ecosystem service concept. *Gaia-Ecological Perspectives for Science and Society*, 16: 215–221.

Ghazoul, J., Garcia, C. & Kushalappa C.G. 2009. Landscape labelling: A concept for next-generation payment for ecosystem service schemes. *Forest Ecology and Management*, 258: 1889–1895.

Grieg-Gran, M., Porras, I. & Wunder, S. 2005. How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. *World Development*, 33: 1511–1527.

ICRAF. 2008. *Social mobilization and local awareness of rights and opportunities for environmental services market*. RUPES Synthesis Note. Bogor, World Agroforestry Centre (ICRAF).

Koh, L.P. & Ghazoul, J. 2008. Biofuels, biodiversity and people: Understanding the conflicts and finding opportunities. *Biological Conservation*, 141: 2450–2460.

MEA. 2005. *Ecosystems and human well-being: Synthesis*. Washington, D.C., Island Press.

Muñoz Piña, C., Guevara, A., Torres, J. & Brana, J. 2008. Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. *Ecological Economics*, 65(4): 725–736.

Pagiola, S., Ramirez, E., Gobbi, J., De Haan, C., Ibrahim, M., Murgueitio, E. & Ruiz, J.P. 2007. Paying for the environmental services of silvopastoral practices in Nicaragua. *Ecological Economics*, 64: 374–385.

Pagiola, S., Rios, R.S. & Arcenas, A. 2008. Can the poor participate in payments for environmental services? Lessons from the Silvopastoral Project in Nicaragua. *Environment and Development Economics*, 13: 299–325.

Smith, J. & Scherr, S.J. 2002. *Forest carbon and local livelihoods: Assessment of opportunities and policy recommendations*. CIFOR Occasional Paper, No. 37. Bogor, Center for International Forest Research (CIFOR).

UNESCO. 2008. *Biosphere reserves: Reconciling the conservation of biodiversity with economic development* (available at http://www.unesco.org/mab/BRs.shtml).

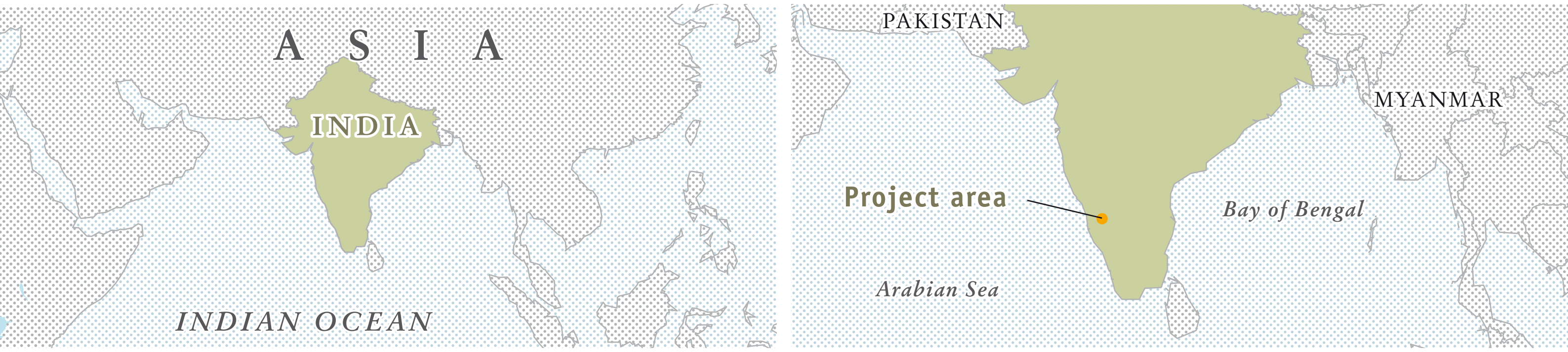
Wunder, S. 2005. *Payment for environmental services: Some nuts and bolts*. Jakarta, Centre for International Forestry Research (CIFOR).

Wunder, S. 2008. Payments for environmental services and the poor: Concepts and preliminary evidence. *Environment and Development Economics*, 13: 279–297.

Wunder, S. & Albán, M. 2008. Decentralized payments for environmental services: The cases of Pimampiro and PROFAFOR in Ecuador. *Ecological Economics*, 65: 685–698.

GEOGRAPHICAL INDICATIONS AND LANDSCAPE LABELLING IN KODAGU DISTRICT, INDIA

Claude Garcia[1], *Jaboury Ghazoul*[2] *and Cheppudira Kushalappa*[3]
[1]La recherche agronomique pour le développement (CIRAD), Montpellier, France
[2]Institute of Terrestrial Ecosystems, Swiss Federal Institute of Technology Zurich (ETH), Zurich, Switzerland
[3]College of Forestry, Ponnampet, India

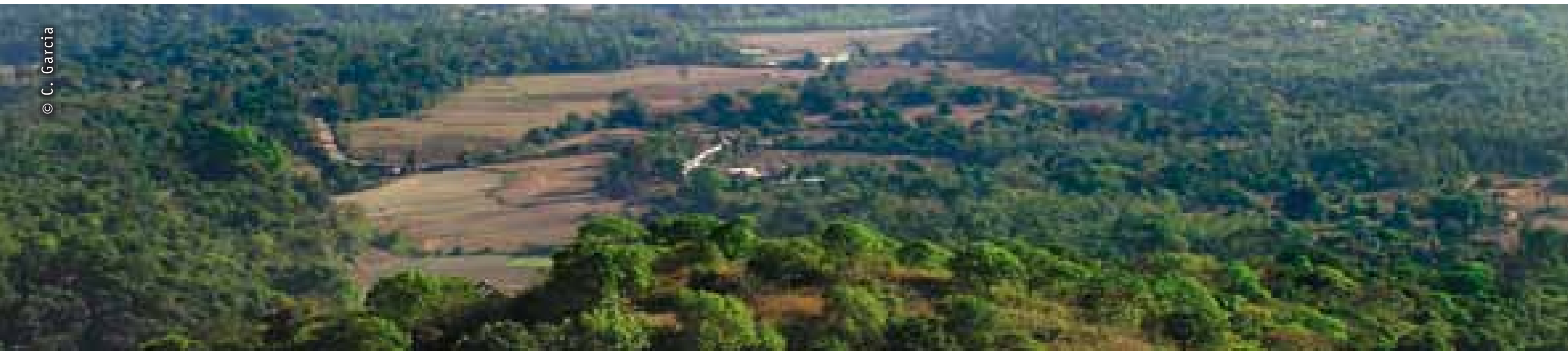


The district of Kodagu (informally known as 'Coorg') in the state of Karnataka is a major coffee-growing region located in the mountain range of the Western Ghats, India. It produces nearly two percent of the world's coffee (Coffee Board of India, 2008), mostly in agroforestry systems under native tree cover. The district has 150 inhabitants per km² and despite this high density, still harbours important populations of flagship species, such as the tiger (*Panthera tigris*) and the Asian elephant (*Elephas maximus*).

Before the development of coffee, rice was the main crop, cultivated in terraced fields in the lowlands. Adjoining the rice paddies fields were large tracts of wet evergreen and moist-deciduous forests. These forests provided farmers with a variety of goods and services, for example, the transfer of fertility from forests to farmland in the form of green manure, provision of firewood, timber and non-timber forest products. With the development of the plantation economy, the rice paddies and the forests became less valuable. From 1977 to 1997 there was a 30 percent loss of forest cover in Kodagu, while the area under coffee doubled, predominantly at the expense of privately owned forest fragments (Garcia and Pascal, 2006). Today, coffee plantations occupy 33 percent of the district; the transformation of Kodagu has wider implications for ecosystem services, such as biodiversity, scenic beauty and the cultural significance of this landscape (Figure 25 and 26).

Four major ecosystem services are provided by the coffee agroforestry landscape: (a) it contributes to the ground water recharge; (b) it acts as a carbon sink compared to other cultivated land uses; (c) it maintains high levels of biodiversity; and (d) it has aesthetic values that are appreciated by a burgeoning tourist population.

Geographical Indications and coffee certification schemes, or even a landscape labelling approach, could link sustainable management and environmental benefits of coffee agroforests with appropriate remuneration for producers through better access to markets and PES, and improve livelihoods for coffee farming communities, while conserving natural resources in a major coffee agroforest region located in a world hotspot for biodiversity.



GEOGRAPHICAL INDICATIONS (GI) IN KODAGU[1]

India protects its origin-based products and associated traditional knowledge through the promotion of Geographical Indications, with a *sui generis* protection system that is looked upon as a model for other countries. Conflicts over Basmati rice and Darjeeling tea have created a nationwide awareness and, in accordance with the World Trade Organization (WTO) agreement on TRIPS, India passed the Geographical Indication of Goods Act in 1999, which entered into force in 2003.

The Department of Horticulture of the Government of Karnataka filed an application for a GI Coorg orange, which was registered in 2004. The Coorg orange (*Citrus reticulata*) is an ecotype of mandarin. It is a small tree that grows well in evergreen, subtropical, hilly tracts at 600-1 200 metres above sea level. The Coorg orange was frequently associated with coffee, but diseases and lack of interest by farmers who were eager to involve themselves in more lucrative cash crops (coffee and pepper) has almost entirely wiped out the crop over the last 50 years. The Department of Horticulture has sought to protect and revive the Coorg orange traditional crop variety and to provide high quality (disease-free) plant material, bringing economic development to the region. The GI is being used to protect the ecosystem where the orange is grown and protect the association between the product and its origin locality.

The GI may have prevented the Coorg orange from disappearing, but it is doubtful that the GI on Coorg orange will have an impact on the biodiversity and landscape dynamics of Kodagu owing to: (a) the way the GI was initiated, via a government agency speaking on behalf the producers, rather than the producers themselves; (b) the fact that the specification was not drafted with the objective of maintaining and fostering multifunctionality within the landscape; and (c) the lack of local awareness about the GI tool or the ecosystem services provided by the landscape.

1 Garcia *et al.*, 2007

Current pages (from left to right):

→ State-controlled forests, rice paddies, coffee plantations and forest patches constitute the landscape of Kodagu district.

→ Large-scale conversion of forests to coffee plantations has eliminated important ecological corridors between forest remnants causing serious human-elephant conflict in Kodagu district.

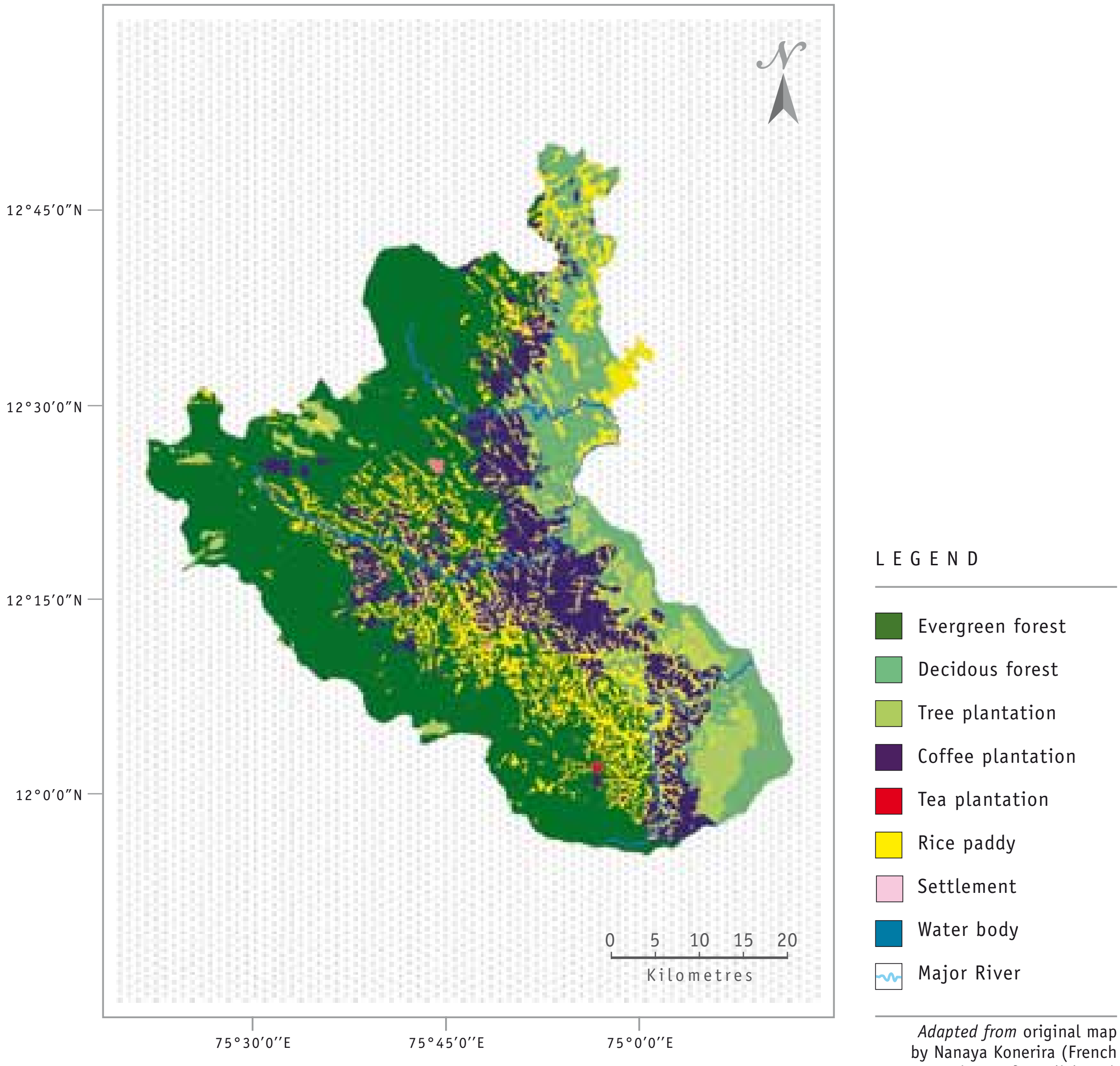
The Coorg green cardamom GI, filed this time by the Spices Board, is also registered and suffers from the same drawbacks. As of today, there is no GI on coffee, despite this being the most prominent product of the area, with a well established reputation and the geographical name being used by private companies to market generic coffee powder.

For a GI to be successful it needs to secure income for the producers and for this it needs to be filed or at least appropriated by the producers. For a GI to be successful in protecting biodiversity, environmentally-sound practices need to be embedded in the specification of the GI. However, choosing environmentally-sound practices entails opportunity costs that need to be taken into account lest the GI becomes no longer profitable and, therefore, defeats its original purpose.

COFFEE CERTIFICATION SCHEMES IN KODAGU

Despite the high levels of biodiversity that have been documented in the coffee agroforestry landscape of Kodagu, eco-labelling of coffee was absent from the region until 2008. The majority of Kodagu's farmers are smallholders and to source sufficient volumes of quality coffee produced in a sustainable manner has been a challenge for any certification scheme. Under the EU-funded Coffee Agroforestry Network (CAFNET) project, an initial group of six farmers were certified by the Rainforest Alliance and/or UTZ-certified in 2009 and so secured better prices for their coffee. Currently, 90 farmers are under review for certification, based on a voluntary process led by the farmers themselves with support from the two leading coffee trading companies in Kodagu. The cost of the certification is borne by these companies, though the Coffee Board of India recently announced a subsidy scheme to encouraging certification programmes among growers. The CAFNET project facilitates these activities by helping the farmers document their management practices and biodiversity, improve their record-keeping and design internal controls.

Figure 25
Land cover of Kodagu district in 1977



Adapted from original map by Nanaya Konerira (French Institute of Pondicherry)

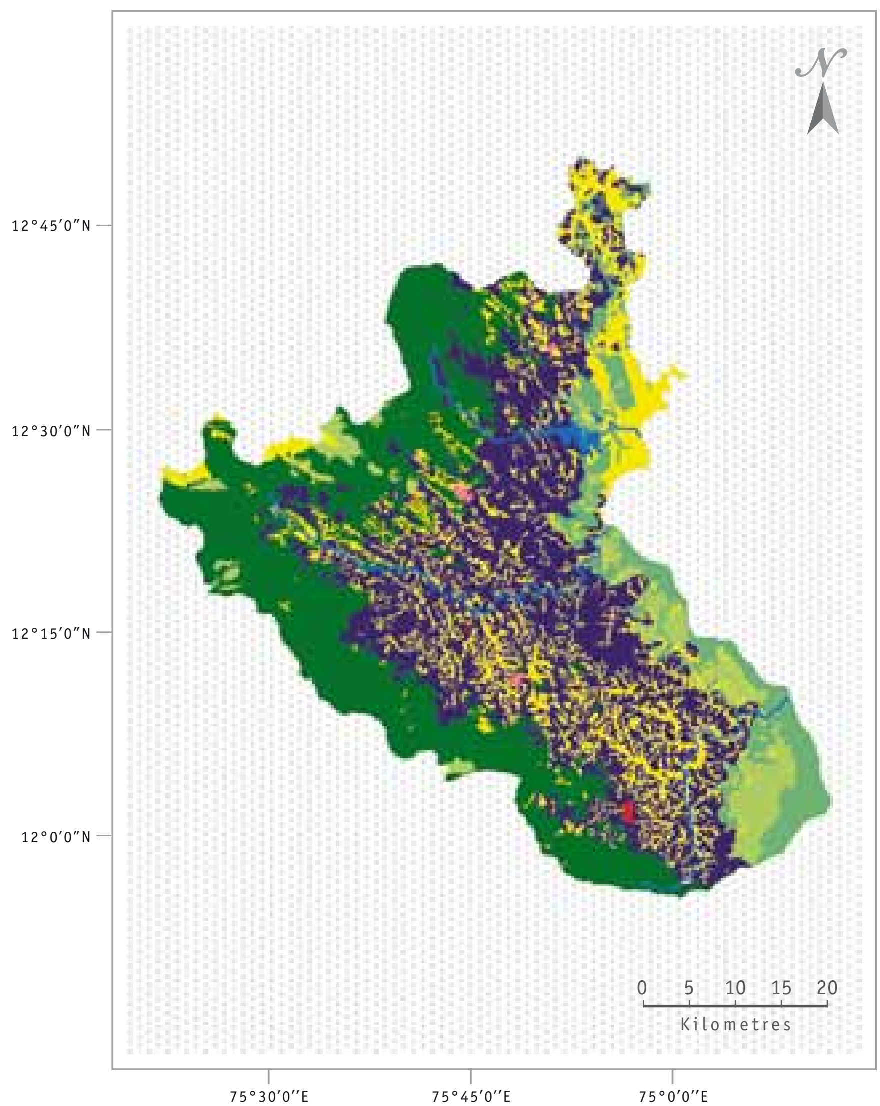
Current pages (from left to right):

→ Heavily pruned forest trees allow the cultivation of shaded-coffee cultivation.

→ Example of a sacred forests near the source of the Kavery River in Kodagu district, where one sacred forest is found for every 300 hectares, giving to the landscape a strong cultural value.

→ Cardamom (*Elettaria cardamomum*) used to be the main cash crop of Kodagu district long before large-scale coffee cultivation was introduced by the British.

Figure 26
Land cover of Kodagu district in 2007



LEGEND

- Evergreen forest
- Decidous forest
- Tree plantation
- Coffee plantation
- Tea plantation
- Rice paddy
- Settlement
- Water body
- Major River

Adapted from original map by Nanaya Konerira (French Institute of Pondicherry)

© G. Balent and G. Micho


© G. Balent and G. Michon

LANDSCAPE LABELLING IN KODAGU

Landscape labelling is a concept that combines ideas drawn from PES with product certification concepts. Kodagu potentially delivers a wide range of ecosystem services that benefit the local, regional and global community and yet is undergoing a transformation that is likely to undermine the ability of the landscape to provide these services. A valuation of the ecosystem services provided by the Kodagu landscape could provide the basis for a bundled payment for these ecosystem services. Payments under such a scheme would be conditional upon the continued delivery of the services which (for most services) is a function of the aggregated land uses across the landscape and the payments would be made not to private landowners, but to community-wide institutions such that the benefits of PES are realized at the community level. Because a landscape label implicitly recognises that the appropriate scale for ecosystem service assessment is that of the landscape, the recognition afforded by a landscape label could be applied to any commodity produced by farmers within the landscape. A landscape label is, therefore, not product specific. It also relieves individual farmers from the costs of adoption and verification, although such costs would be transferred to the community organizations receiving the payment. Such organizations are, however, better positioned to negotiate with ecosystem service buyers (companies, NGOs, government organizations, etc.) and secure subsidies.

Were a Kodagu landscape label to emerge, the Kodagu brand would achieve enhanced recognition and increased market visibility through the use of the landscape label as a symbol of effective environmental management. Other products from Kodagu could, under landscape labelling, legitimately use the same Kodagu brand name signifying their origination from a landscape that is delivering a wide variety of ecosystem services. Through this, they could gain market recognition by association, as well as recognition of the ecosystem service values they represent. Finally, services and specifically eco-tourism would benefit from the increased recognition and the standards of quality the label could enforce.

© G. Balent and G. Michon

Current pages (from left to right):
→The homestays agroforestry system is increasingly attracting visitors from Bangalore.
→Honey from Coorg (the English name of Kodagu) has a good reputation but, without Geographical Indication, most of what is sold is a blend of different origins.
→Gathering firewood is one of the main needs of local people and agroforestry can reduce the pressure on natural forests.

Finally, intangible values could be embedded in the landscape label, to reflect the specific cultural and religious values attached to the landscape and specifically its sacred forests and pilgrimage sites, such as the source of the Kavery River. This would empower local communities in their actions to conserve such features in the face of external development pressures (Garcia and Pascal, 2006).

Landscape labelling in Kodagu could be implemented through the Kodagu Model Forest Trust (KMFT), a partnership of organizations representing diverse groups that have interests in the environment and management of the Kodagu landscape. It includes as its members organizations representing landholders, NGOs, the Karnataka Forest Department, community groups, research institutions. Furthermore, it encompasses groups that represent a variety of stakeholders ranging from government representatives, farmers and village representatives, as well as scientists and other experts. While it does not yet include representatives from the landless poor and tribal communities, there is the potential to develop the network in this direction. Hence, landscape labelling payments for ecosystem services could be made to a community-based institution, such as KMFT, which would be responsible for the investment of such funds in social and development projects and infrastructure to the benefit of all people living within the landscape, not only to private landowners.

REFERENCES

Coffee Board of India. 2008. *Coffee Board of India website* (available at http://www.indiacoffee.org/default.php).

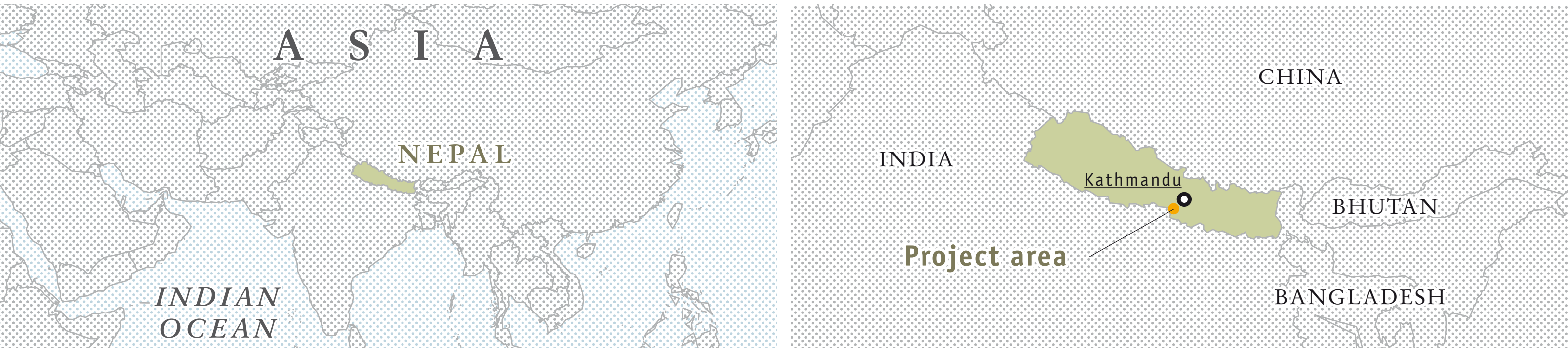
Garcia, C. & Pascal J.P. 2006. Sacred forests of Kodagu: Ecological value and social role. *In* G. Cederlof & K. Sivaramakrishnan, eds. *Ecological nationalism: Nature, livelihoods and identities in South Asia*, pp. 199–229. Seattle, University of Washington Press.

Garcia, C., Marie-Vivien, D., Kushalappa, C.G., Chengappa, P.G. & Nanaya, K.M. 2007. Geographical Indications and biodiversity in the Western Ghats, India. *Mountain Research and Development*, 27(3): 206–210.

A COMMUNITY-BASED PES SCHEME FOR FOREST PRESERVATION AND SEDIMENT CONTROL IN KULEKHANI, NEPAL

Laxman Joshi
International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal

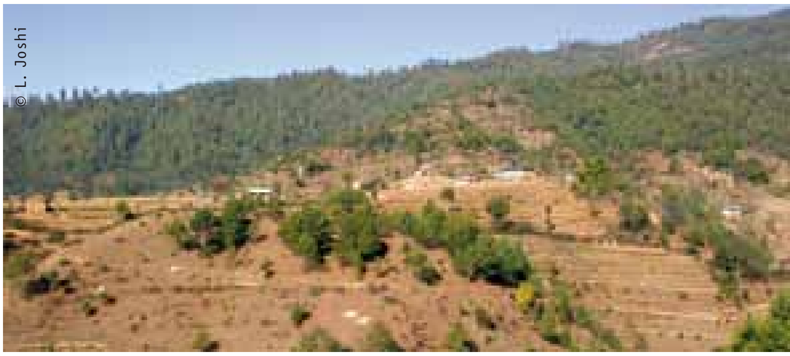

© L. Joshi



Kulekhani, which in Nepalese means 'mine of water', is a 12 500 ha watershed in Makwanpur district about 50 km southeast of Kathmandu, Nepal. More than 46 000 people from 8 600 households in eight villages live in the catchment area. Poverty persists in numerous villages in the catchment area and many households practice a subsistence economy based on sloping land agriculture (on an average of 0.6 ha of land per household), livestock rearing and the use of forests for fuelwood, fodder and litter. Intensive agriculture for commercial vegetable production and paddy rice is increasing. Forests, although legally owned by the state, were traditionally managed by local communities. In 1957, the government, aiming to protect and increase forest cover, nationalised forests, marking their boundaries, restricting access and employing forest guards for patrolling them. Ironically, this nationalisation policy led to major deforestation partly due to inefficient protection measures and the exploiting attitude of local communities who felt expropriated from their forests. Thus, in the 1980s, to try to re-establish some level of forest protection, the government launched a national community forestry programme, in which the government granted user rights of the forest to a group of households. The community forestry programme has been hailed as a success in the country. In Kulekhani, 95 percent of the forests are now community managed and forest cover is recovering well.

In 1982, on the site of the Indra-Sarobar Lake, the Kulekhani reservoir was built to collect monsoon rain and channel water from the reservoir to the hydropower plant downstream. Later, a second hydropower plant was added below the first plant (Figure 27). The Kulekhani hydropower plants now provide 17 percent of the total hydroelectricity generated in Nepal. Eighty percent of the annual rainfall falls during the four monsoon months (June-September). Annually, the watershed receives between 1 500 and 1 700 mm of rain, but annual variation can be high. In July 1993, 542 mm of rain fell within a 24-hour period, resulting in many landslides and massive sedimentation in the reservoir.


© L. Joshi

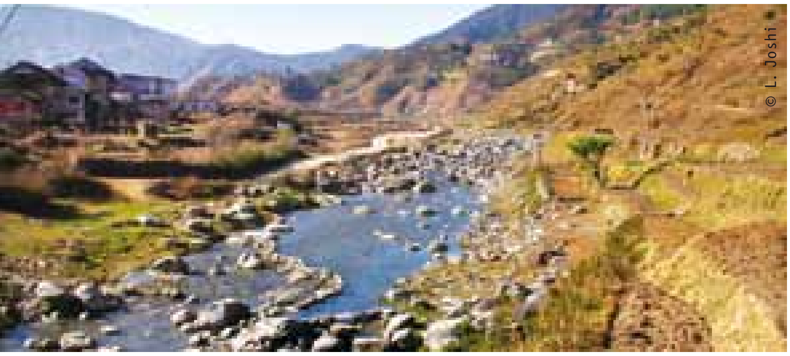

© L. Joshi

A hill above the reservoir, that was partially excavated for earth for the dam, was washed into the reservoir. The reservoir, designed to have a 100-year lifespan based on projected sediment rates, had its life expectancy reduced to a third in a single day!

Given the economic importance of the Kulekhani hydropower plants and the need to properly manage the catchment area, the government promoted participatory watershed conservation programmes in which local people were employed to build sediment-trap dams to intercept any sediment before it reaches the reservoir and adopt measures to control gullies. The government planted large pine monocultures on both state forest and village lands and encouraged people to plant pine trees on their agricultural terraces by providing farmers with free seedlings.

In 2003, the RUPES programme of ICRAF, in collaboration with Winrock International, initiated work to establish a PES scheme between the upland communities in the Kulekhani watershed and the Kulekhani hydropower plant. By law, all hydropower plants must pay royalties to the government which, in turn, channels the money at various levels to development activities. According to prevailing government regulations (the Local Self Governance Act of 1999 and the Financial Ordinance of 2004), 12 percent of the government-collected royalties should be used in the district that houses the hydropower plant (38 percent is allocated for other districts in the development region and the remaining 50 percent is for other development regions of the country). Hence, the Makawanpur District Development Committee (DDC) receives 12 percent of the royalties paid by the Kulekhani hydropower plants to the government. Usually, however, this money would be used as a part of the regular budget for Village Development Committees' (VDCs) projects and the money is not specifically for meeting the needs of upland communities. Thus, within this regulation framework, a PES scheme could be established in different ways:

a. The hydropower company could directly pay a portion of its revenue from electricity sales to the upland people for their ecosystem services;
b. The government of Nepal could allocate a portion of its hydropower royalties from the Kulekhani hydropower plants to the upland communities;



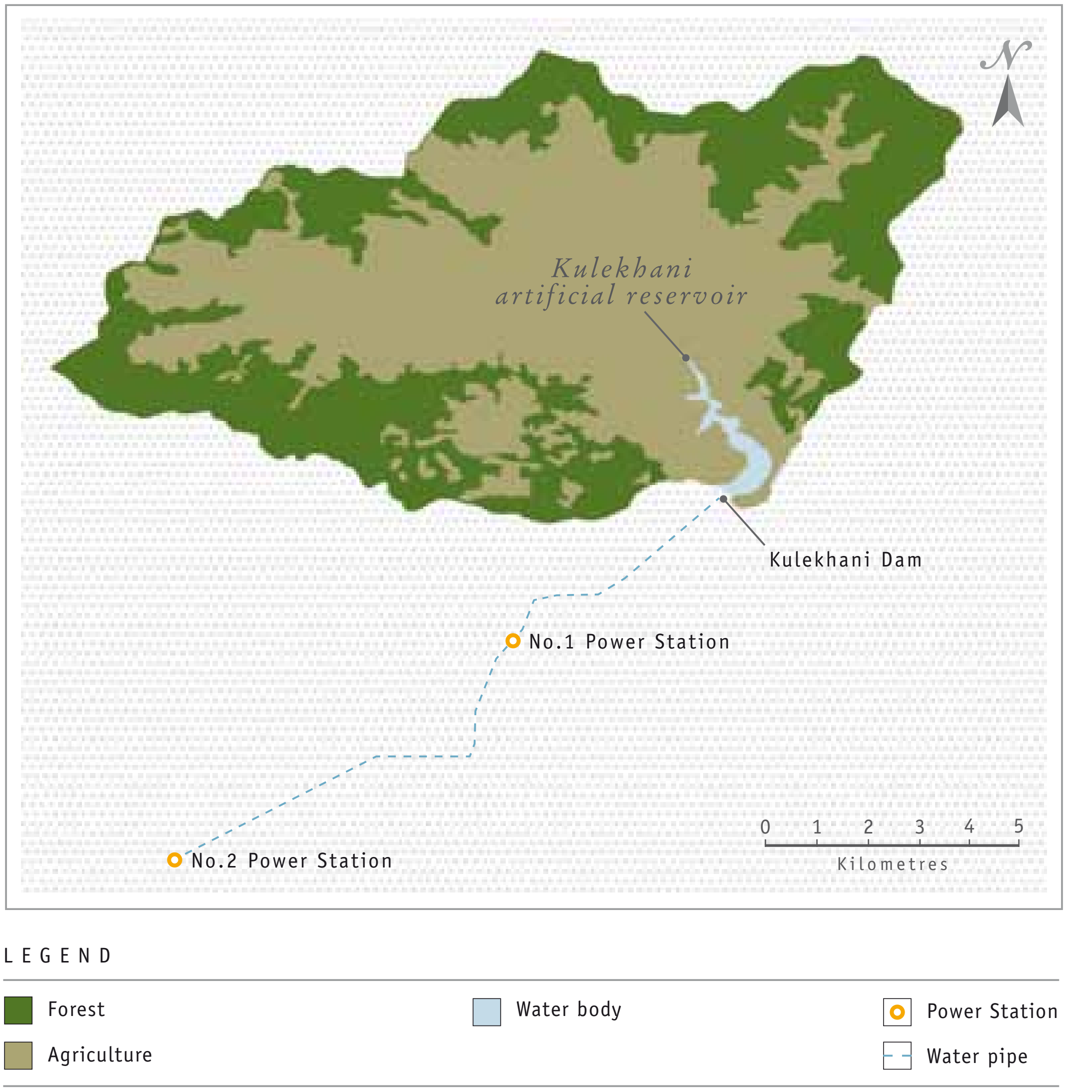
Current pages (from left to right):

→ The 7 km-long Kulekhani artificial reservoir collects all the water drained from the 12 000 hectare Kulekhani Watershed.

→ Terracing permits farmers to grow crops on steep slopes on soils that once deforested would otherwise have long since washed away without such measures.

→ Palung village next to the Kulekhani River, which receives water from eight sub-watersheds: Palung, Kitini, Kunchhal, Bisingkhel, Tubikhel, Simlang, Nalibang and Tasar.

Figure 27
Land cover of the Kulekhani Watershed in 2005



Adapted from ICRAF unpublished report

c. Makwanpur district could set aside a portion of its hydropower royalties from the central government for the upland communities.

Under the prevailing laws and as advised by major stakeholders, a mediated scheme between Makwanpur DDC and upland communities was considered the most feasible option. Based on the work of Winrock International and RUPES, in 2006, the Makwanpur DDC passed a regulation that specified allocation of the 12 percent royalty received from the government. Known as the Hydropower Royalty Distribution and Use Directive 2062, the DDC must now spend half of the 12 percent royalty in the hydropower plant-affected area, while the remaining half can be used in other areas of the district. The regulation further specifies that of the 50 percent allocation to the affected area, 20 percent is for the upstream watershed area (catchment), 15 percent for the surrounding area (affected by power plant infrastructure) and the remaining 15 percent for the downstream area (because of reduced water in the river due to the water diverted to the turbines). The upstream catchment community, thus, receives a bigger proportion of the royalty than the other areas; the money is deposited in the Environmental Management Special Fund (EMSF), managed by the DDC. The money can be used to support conservation and development programmes proposed by watershed communities. The EMSF is considered a payment to upland watershed communities for providing ecosystem services. The EMSF received about USD 3 000 in 2006-2007, about USD 5 000 in 2007-2008 and about USD 10 000 in 2008-2009. The 2009-2010 allocation remains pending though due to local conflict. The Makawanpur DDC directive has since been accepted and circulated by the government to be implemented in all districts of the country.

Established with support from RUPES, the Kulekhani Watershed Conservation and Development Forum was active in raising awareness amongst local people about ecosystem services, the role of communities and the choices made by the government in the previous decades that are currently affecting their livelihoods. The planting of pine trees on a large scale in the catchment area has been criticised by the local people, as it means there is less fodder for livestock.

Current pages (from left to right):
→ Reforesting the upper Kulekhani catchment with pine trees to reduce soil erosion has been actively pursued by the government, although residents now lack enough fodder resources for their livestock.
→ Intensively cultivated vegetable plots on the lowland along the river system.
→ The Kulekhani watershed has a population of over 100 000 inhabitants for whom agriculture is the major livelihood source.

Protection of young plantations and community forests has also resulted in people switching from free-roaming cattle to stall-feeding of their animals and from traditional fallow rotations to permanent-field agriculture.

The Kulekhani experience demonstrates that a PES scheme can be issued at the community level and is not necessarily constrained by individual choices and land tenure issues. The long-tradition of forest management at the community level was certainly a major strength in this type of implementation. The major weakness was instead related to the indirect payment scheme, mediated by a government body (Makwanpur DDC), which has made the project vulnerable to local conflicts and political instability. As such, although the local bodies (i.e. DDCs and VDCs) were empowered by the 1999 Local Self-Governance Act and the 1992 Decentralisation Act, with authority, responsibility and accountability in management and distribution of local resources, the current conflict in the use of the available budget is hampering the effective ongoing implementation of the PES scheme.

REFERENCES

Adhikaree, K. 2010. *Socio-technical assessment of payment for environmental services (PES) scheme: A case study of Kulekhani watershed, Nepal*. Asian Institute of Technology School of Environment, Resources and Development, Thailand. (Thesis of Master of Science in Natural Resources Management)

Ghimire, B.N. 2004. *Economic losses to Kulekhani hydroelectric project due to siltation in the reservoir*. Final report. Kathmandu, Winrock International.

ICRAF. n.d. *Site profile: RUPES Kulekhani*. Bogor, World Agroforestry Centre (ICRAF) (available at http://www.worldagroforestrycentre.org/Sea/Networks/RUPES/download/SiteProfiles/RUPES-Kulekhani-FINAL.pdf).

Karki, B.S. & Joshi, L. 2009. *Payment for environmental services – An approach to enhancing water storage capacity*. Sustainable Mountain Development, No. 56. Kathmandu, International Centre for Integrated Mountain Development (ICIMOD).

CHAPTER

7

ENABLING CONDITIONS AND COMPLEMENTARY LEGISLATIVE TOOLS FOR PES

Thomas Greiber
IUCN Environmental Law Centre, Bonn, Germany

CONTENTS

ABSTRACT

In order to ensure the sustainable provision of ecosystem services and to deter their further degradation, economic and market-based mechanisms, such as Payments for Ecosystem Services (PES) schemes, provide new policy instruments. PES schemes aim at creating positive attitudes and stimulating proactive behaviour towards the development and utilisation of nature-based solutions, which means a considerable shift from the application of classic 'command-and-control approaches' that aim at discouraging certain environmentally harmful behaviours.

The following chapter will explain why, depending on the type of PES scheme and the scale at which it is developed (local to international), legal frameworks play an increasing role in supporting successful PES development and how they provide a key instrument to ensure good PES governance. At the same time, experiences from around the world are provided in order to show that a lack of or inappropriate legal frameworks have the potential to obstruct effective PES implementation.

Furthermore, some of the greatest challenges in the development of PES initiatives will be addressed. Flexible approaches in dealing with unclear or inexistent property rights have to be taken in order to ensure a minimum of legal certainty and thus effectiveness when developing PES initiatives. Also, the creation of an enabling legal environment will be discussed which can stimulate a more efficient use of PES financial resources and promote the integration of different PES or ecosystem services related activities.

INTRODUCTION

Human well-being generally requires basic matters necessary for a good life, starting with food, water and shelter. Beyond that, people need to be healthy, feel secure in their social networks and have the freedom to make their own decisions. The Millennium Development Goals (MDGs) reflect these prerequisites for human well-being.

Many of these needs involve the environment in general and ecosystems in particular. Especially poor people living in a rural environment depend on fertile soils and regular rainfall, natural pollination and natural regulation of pests for successful agriculture. Their survival also requires the existence of wild plant and animal species for gathering and hunting food or traditional medicines, access to freshwater for drinking, the availability of firewood for heating and energy and the maintenance of 'green infrastructure' in general as a natural platform for resilience (e.g. mangroves and coral reefs as a natural protection from storms and floods). Even outside rural communities, human health and safety is closely related to the environment and nature. For example, even in developed countries a considerable number of diseases, casualties and deaths are clearly linked to poor water quality, natural disasters, or new pandemics (such as the avian influenza or swine flu). Nature and its biodiversity provide effective and often cost-efficient response instruments in these regards, including water filtration and climate regulation systems and pathogens for vaccination and medication.

These instruments are based on and provided by ecosystems. As they improve human conditions, the term 'ecosystem services' has been created. The environment and its different ecosystems provide a wealth of services. "These include provisioning services, such as food and water; regulating services, such as regulation of floods, drought, land degradation and disease; supporting services, such as soil formation and nutrient cycling; and cultural services, such as recreational, spiritual, religious and other non material benefits" (MEA, 2005). However, due to increasing rates of environmental degradation and to the greater demand for ecosystem services, the environment is now faced with a limited capacity to produce such services. In order to ensure the durability of ecosystem services and to deter their further degradation, the standard legal approach is the so-called 'command-and-control'. Most environmental law falls into this general category of command-and-control laws, which typically involve three elements: (a) identification of a type of environmentally harmful activity, (b) imposition of specific conditions or standards on that activity, and (c) prohibition of forms of the activity that fail to comply with the imposed conditions or standards, coupled with sanctions to deter such activity in the future. In short, command-and-control laws aim at discouraging certain environmentally harmful behaviours. However, they do not encourage positive attitudes which lead to proactive behaviour.

Instead of sanctioning violations of environmental standards, economic incentives are created to promote the sustainable delivery of ecosystem services

As a consequence, economic and market-based mechanisms, such as Payments for Ecosystem Services (PES) schemes, have lately become popular as they present 'new' or alternative approaches for the conservation of ecosystems and their services. Instead of sanctioning violations of environmental standards, economic incentives are created to promote the sustainable delivery of ecosystem services. The PES concept is based on the idea of establishing appropriate prices on ecosystem services and using financial incentives combined with legally-binding agreements for promoting their conservation. The common denominator across such PES schemes is that payment arrangements are made where those who pay are aware that they are paying for an ecosystem service that is valuable to them or their constituencies; and those who receive the payments engage in meaningful and measurable activities to ensure the sustainability of the ecosystem in question (Gutman, 2007). PES schemes, thus, differ considerably from command-and-control laws in that they:

- Are based on voluntarism and negotiation, instead of strict obligation and top-down imposition;

- Reflect the paradigm of internalising externalities by creating market mechanisms for exchanging ecosystem services between providers and beneficiaries;
- Involve property rights holders and recognise their interests, instead of simply restricting their rights;
- Have the potential to achieve additionality, as they usually promote conservation activities which go beyond the pre-existing, mandatory environmental standards.

The focus of this chapter is on legal frameworks that can either enable the successful development of a PES scheme or obstruct its effective implementation. Indeed, according to the different types of PES schemes (private, public or trading schemes) and the scale at which they is being established (local, regional, national or international), the legal basis and requirements will differ greatly.

TYPES OF PES SCHEMES AND THE IMPORTANCE OF LEGAL FRAMEWORKS

As mentioned before, three types of PES schemes are generally distinguished: private schemes, public schemes and trading schemes (Table 9). While the objective of all of these schemes is the protection, conservation or restoration of ecosystem services, each type differs substantially from the other in view of actors, development, setup and also complexity.

Private PES schemes

Private PES schemes are driven by the market and can be developed independently of any governmental support

Private PES schemes are driven by the rule of supply and demand. If a person has a demand for ecosystem services to be provided and another private person is in a position to offer such services, a private PES contract can be developed independently of any governmental support. An example of this is the private PES scheme in the Vittel (Nestlé Waters) case (Perrot-Maître, 2006). Thus, private PES schemes can be developed without a specific PES legal framework. Instead, they only require:

- Basic contract law which provides contracting parties with sufficient legal remedies to enforce contract rights in cases of non-compliance with contract obligations;
- A legal system based on the legal principle of *pacta sunt servanda*, meaning that agreements must be kept, as well as general respect for the rule of law;
- Absence of any legal provision which could be interpreted as prohibiting PES contracts and their subject matter.

Table 9
Legal complexity of different PES schemes

Type	Development/Actors	Set-up	Complexity
Private	❊ Self-organized ❊ Providers and beneficiaries are private entities (individuals, groups of individuals, private companies) ❊ Government/public entity only as intermediaries (if at all)	❊ Direct payments by service beneficiaries to service providers ❊ Cost-sharing among involved private parties ❊ Purchase of land and lease back to former owner ❊ Purchase of development rights to land which are separated from property rights	Low
Public	❊ Government-driven ❊ Involving private and public entities ❊ Government/public entity either as provider or beneficiary	❊ User fees ❊ Fiscal instruments (taxes or subsidies) ❊ Land purchase ❊ Granting of rights to use land and resources	Medium to high
Trading	❊ Government- and market-driven ❊ Involving private and public entities ❊ Government sets up a real market	❊ Cap (aggregate maximum amount) for pollution or conversion of ecosystems, or extraction of natural resources ❊ Allocation of permits (for pollution, conversion or extraction) which divide allowable overall total among users ❊ System for banking permits and their trading between those who do not need permits and those who need more than their allocation	High

However, it has to be noted that such private PES schemes that are developed without a specific PES vision and legal regime are usually limited to the local scale where they only address specific environmental problems or undertake individual, stand-alone activities. Thus, their objective is not to have an impact at a greater, national, regional or global level. Yet, they have the potential to contribute to the conservation or provision of ecosystem services at larger scale, if a nested approach is being applied which will connect the different local activities. Such a nested approach, again, requires an enabling framework comparable with public PES and trading schemes.

Public PES schemes

In contrast to private PES schemes, public PES schemes require at least a clear legal basis for the respective public entity to enter into a PES contract. Private individuals or entities are generally free to take action. They also automatically become contractually capable if certain prerequisites are fulfilled (e.g. a certain age of an individual, or a certain legal status of a private company). In contrast, public entities must be legally empowered to become active and a contracting party.

Such legal bases for public-private PES schemes can be found in many countries. For example, the German Federal Nature Conservation Act (*Bundesnaturschutzgesetz*), as amended on 29 July 2009, aims at improving cooperation between nature users and conservationists by strengthening the role of contract-based nature conservation. In its Article 3.3, the German Federal Nature Conservation Act foresees that one priority of governmental authorities will be to determine whether nature conservation measures can be implemented more effectively through contractual agreements (e.g. between nature conservation agencies and landowners), rather than through regulation. This provides a clear mandate for public authorities and encourages them to enter into PES contracts. Furthermore, this provision could even be interpreted as giving a preferential treatment to PES, as compared to command-and-control regulations. Furthermore, if good governance is taken seriously in public-private PES schemes, a number of other requirements should be fulfilled:

Public PES schemes require at least a clear legal basis for the respective public entity to enter into a PES contract

- **The general process for engaging in PES contracts should be clear:** Public entities have different possibilities to take action, including the 'classic' legal instrument of an administrative act, but also the instruments of public-private or private contracts. The requirements and the process for entering into such contracts in general and into PES contracts in particular have to be clarified in order to improve coherence and legal certainty. For example, when developing PES contracts, the public entity might require a specific application process for interested service providers, which helps to screen potential contracting partners. At the same time, eligibility criteria for PES participants have to be defined. Based on these criteria, the public entity will be obliged to comply with the general rule of non-discrimination, which means that it must not discriminate between equal partners in the application process.
- **The public funds and/or goods should be collected and invested on the basis of clear legal and procedural frameworks:** Laws and regulations have to decide how to generate financial resources for public PES investment. Collecting such resources (e.g. through taxes, fees, levies, trust funds, government bonds, etc.) requires a legal basis. At the same time,

it has to be decided whether to create a special PES fund to manage the resources and, if so, rules have to be established on how to govern this fund. Furthermore, clear regulations have to be developed on how to invest the resources. For example, a maximum or minimum amount for PES payments can be set, it can be decided whether to allow only payments in cash or also in kind, etc. Finally, it has to be determined how to use public goods in general (e.g. publicly-owned land) as part of PES schemes.

- **Transparency should be ensured by monitoring public PES investment and management through an independent authority:** A legal framework is also particularly important to avoid potential corruption and mismanagement of public resources. A system of checks and balances has to be developed in order to supervise PES investment and implementation. The supervising authority again should be given clear rights and responsibilities established by laws and regulations.

Fulfilling such good governance requirements will help to build trust between service providers and beneficiaries, at the same time contributing to a greater acceptance of PES as a policy instrument within society.

Trading schemes

Trading schemes (cap-and-trade) can relate to different ecosystem services, including carbon emissions reduction, biodiversity conservation, etc. (see also Chapter 3 “Opportunities and gaps in PES implementation and key areas for further investigation”). They generally require a specific legal framework as they are rather complex.

Such a complex cap-and-trade scheme can be found, for example, in the USA where the Clean Water Act (last amendment in March 2008) introduces a wetland mitigation banking scheme. The overall objective of the Clean Water Act is to restore and maintain the chemical, physical and biological integrity of the waters of the USA. To do so, the Clean Water Act prohibits the discharge of dredged or fill material into the country’s waters unless a permit issued by the Army Corps of Engineers or approved state under Section 404 of the Clean Water Act authorises such a discharge. For every authorised discharge, the adverse impacts to wetlands, streams and other aquatic resources must be avoided and minimised to the extent practicable. For unavoidable impacts, compensatory mitigation is required to replace the loss of wetland and aquatic resource functions in the watershed[1].

Trading schemes require specific and rather complex legal frameworks

1 For further information, see the USA Environmental Protection Agency “Mitigation Banking Fact Sheet” at http://www.epa.gov/owow/wetlands/facts/fact16.html.

Compensatory mitigation for unavoidable wetland impacts may be accomplished through distinct mechanisms, including mitigation banking. Such mitigation banking allows land developers to meet their mitigation obligations by purchasing 'credits' from a third-party entity that has created or enhanced wetland resources elsewhere. If well developed, it can have a number of advantages over traditional compensatory mitigation as it has the potential to:

- Reduce uncertainty over whether the compensatory mitigation will be successful in offsetting project impacts;
- Assemble and apply extensive financial resources, planning and scientific expertise not always available to many traditional compensatory mitigation proposals;
- Reduce permit processing times and provide more cost-effective compensatory mitigation opportunities;
- Enable the efficient use of limited agency resources in the review and compliance monitoring of compensatory mitigation projects because of consolidation.

Amongst others, the following issues should be addressed in the legal framework while setting up trading schemes:

- Clear definition of those activities that have a negative impact on ecosystem services and, thus, trigger the mitigation obligations;
- Transparent standards to quantify the unit of exchange (e.g. based on their actual value and/or function, or based on the size and/or geography of the concerned land);
- Determination of units of restored, created, enhanced or preserved ecosystem services which will be converted into tradable credits;
- Procedural frameworks for opening, managing and closing mitigation banks, for ensuring fair trade and for sustainable protection of the resulting ecosystem services;
- Creation of insurance and liability systems to guarantee long-term offsetting and stewardship success.

This means, a clear legal framework for cap-and-trade schemes is not only building an enabling environment, but it is rather a prerequisite for their development.

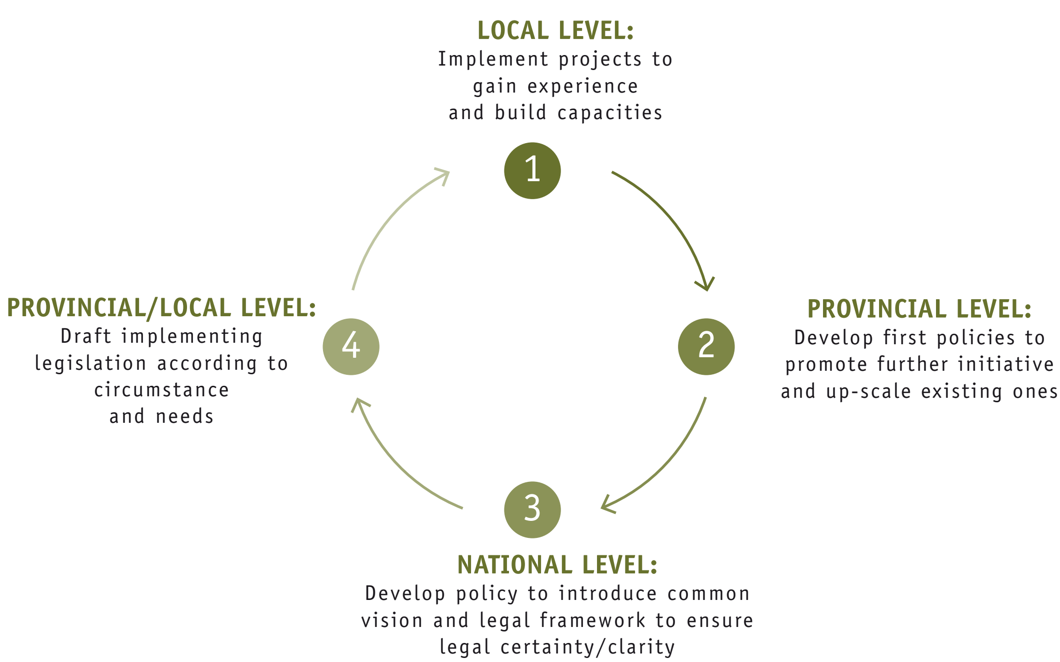
DIFFERENT SCALES AND THE IMPORTANCE OF LEGAL FRAMEWORKS

The importance of appropriate legal frameworks for the development of PES schemes also depends significantly on the scale of the scheme. This becomes evident when taking a closer look at the development of policies and laws related to water PES schemes on the one hand and the setting up of PES schemes related to REDD (Reducing Emissions from Deforestation and Forest Degradation) on the other.

Water-related PES schemes are usually developed at a more local level. Such local schemes generally require less legal guidance from the outset as they are usually focused on very specific water problems. However, by taking a 'learning-by-doing' approach, these local PES schemes, if successful, can trigger the development of policies and laws at the national and even at the regional level. The following four steps (Figure 28) can lead to the development of legal and policy frameworks in a bottom-up approach: firstly, PES projects at the very local level are developed and implemented in order to gain experience and build capacity. In the next stage, lessons learned are drawn from successful PES experiences in order to duplicate these success stories in other local areas and, if possible, at a larger scale. In order to promote such up-scaling, a preliminary PES policy at the provincial level can be a useful tool. Then, national framework legislation can be developed to ensure a common PES vision and understanding, to create legal certainty and to facilitate a coherent and efficient PES approach across administrative and according to ecosystem boundaries. Finally, implementing laws and regulations can be developed at the provincial and local level in order to regulate the necessary details and to steer the next generation of PES projects and schemes.

The importance of appropriate legal frameworks for the development of PES schemes also depends on the scale of the scheme

Figure 28
Water-related PES and its bottom-up policy development process



Adapted from Greiber, 2009

As an example of such a law and policy development process, the case of Bolivia can be cited (Wichtendahl, 2009). Here, PES initiatives were first developed locally with the involvement of local communities, municipal authorities and NGOs. For instance, Fundación Natura, a local Bolivian NGO, developed the Los Negros–Santa Rosa pilot project and later the Mairana, Comarapa and Pampagrande seed fund projects. Thus, PES initiatives were first started at very small and local scales, without either national or departmental PES legislation. Later, these initiatives were replicated and expanded geographically involving more actors. The success of these schemes initially promoted the issuance of a departmental PES policy in Santa Cruz, the 2007 Policy for the Recognition of Ecosystem Services (*Política Pública Departamental para el Reconocimiento de los Servicios Ambientales del Bosque*), followed by the development of the 2008 National Policy for the Integral Management of the Forests (*Política Nacional para la Gestión Integral de los Bosques*). Both instruments helped to formalise the already existing PES initiatives and support the development and implementation of future PES schemes in the country.

A mixture of framework legislation and implementing regulations has the greatest potential for PES

In contrast to water-related PES schemes, the envisaged international REDD regime can be described as a top-down multiple-level PES scheme (Costenbaden, 2009). Here, PES investment would flow first from international public or private sources to national or sub-national level authorities (Figure 29). Such payments need to be managed and coordinated at the national level (e.g. through a national fund and a national REDD Designated National Authority). Subsequently, PES payments would be made between the relevant national or sub-national authorities and project-level participants.[2] This structure already indicates the complexity of the future REDD PES scheme. It would be based on an international agreement setting the overall framework (e.g. determining baselines and safeguards). Furthermore, it would require implementing laws, regulations and policies at the national and sub-national level, in particular clear and equitable rules for benefit-sharing. The general advantages of top-down/centralised or bottom-up/decentralised PES policies and legal frameworks are compared in Table 10.

In practice, the importance of centralisation or decentralisation in PES policies and legal frameworks depends on different factors, such as the overall objective of the PES scheme (dealing with global problems, such as climate change, or with more local problems, such as water supply and quality), or the political structure of a country (centralised or federal state). However, it is important to note that in any case a mixture of a centralised approach through framework legislation and a decentralised approach through implementing regulations at the provincial and local level has the greatest potential to build an enabling environment for PES development.

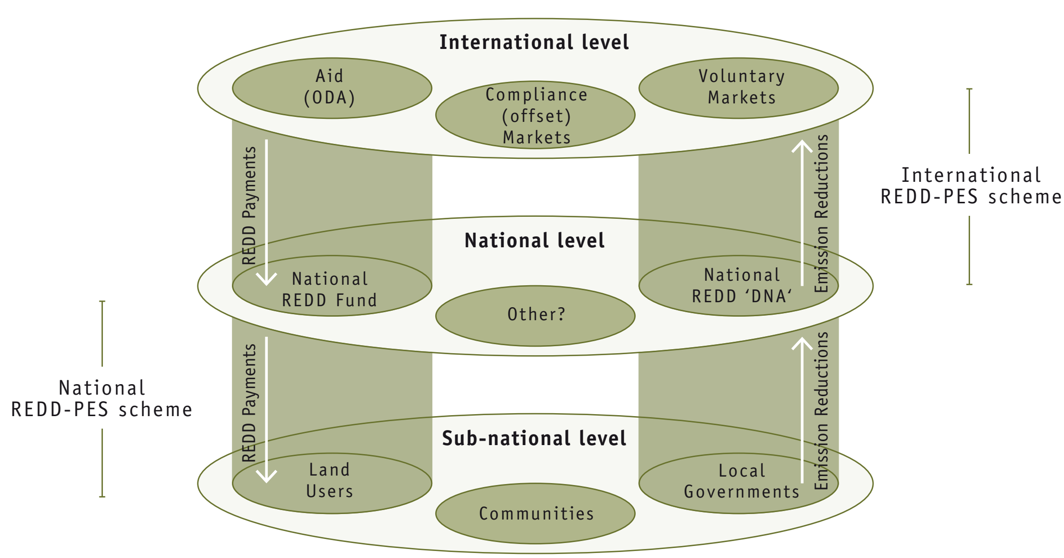
2 Of course, this schematic is rudimentary and does not fully encompass the spectrum of potential design options still undecided in a future REDD regime, which, depending on the chosen finance mechanism and management scheme, may include direct international to sub-national payments.

Table 10
Advantages of centralisation and decentralisation in PES policy development processes

Centralisation	Decentralisation
❊ Support of PES programmes in line with national priorities	❊ Individual responses to regional and local problems
❊ Adoption of unified standards and procedures for effective implementation of PES activities	❊ Adjustment of standardised criteria and procedures according to local circumstances
❊ Coordination of initiatives at inter-regional and international scale	❊ Participation of stakeholders in PES project formulation and decision making
❊ Identification of synergies between different regional and sectoral initiatives	❊ Effectiveness of PES project execution due to information-based decision making
❊ Allocation of human and financial resources according to standardised criteria	❊ Flexibility and efficiency in programme operation, due to less bureaucracy

Source: Greiber, 2009

Figure 29
REDD and its top-down and bottom-up policy development process



Adapted from Angelsen and Wertz-Kanounnikoff, 2008

POSSIBLE LEGAL FRAMEWORKS

Different legal instruments have the potential to create a legal environment which enables or hampers PES development, as outlined in the sections below.

Constitution

While there is no need for constitutional regulation of PES, the constitution must not prevent the development of PES schemes. As the constitution is normally given supremacy over ordinary statutory law, it is crucial that it does not include any provision that directly or indirectly imposes obstacles for the development of PES schemes. Instead, the constitution has a great potential to recognise the value of nature and/or ecosystem services and thereby indirectly promoting the concept of PES.

In Ecuador, for example, the 2008 Political Constitution (*Constitución Política*) recognises the inalienable rights of nature, called ecosystem rights. At the same time, it recognises the right of people to benefit from the environment and from natural resources. Finally, the production, provision, use and exploitation of ecosystem services shall be regulated by the state.

On the one hand, the concept of granting rights to nature and the explicit recognition of ecosystem services are progressive constitutional developments, which have the potential to support the conservation of ecosystem services in the future. On the other hand, it is not yet clear how these ambitious goals can be reconciled and realized in practice, which has lead to a situation of legal uncertainty in the country where the further development of PES may be hampered, rather than facilitated. In addition, the strong role of the state in managing ecosystem services might be interpreted as prohibiting any private engagement through PES.

Specific (P)ES laws

An enabling legal framework for PES could also be created through a specific PES or ecosystem services law. Such laws have the potential to anchor PES cross-sectorally into national or provincial legislation.

In Brazil, for example, promising legal and financial frameworks to support PES development have been created at the state level (Valladares, 2009). The state of Espirito Santo adopted Law No. 8960 in July 2008 which establishes a State Water Resources Fund (*Fundágua*). This fund collects money from different sources, including petroleum royalties, water fees or fines. These can then be invested, amongst others, into PES rewarding rural property owners for the expansion, conservation and/or preservation of forest cover and adequate soil management in areas of relevance for water resources. While other states, such as Amazonas, were also able to develop PES-related legislation in the past, it has proven to be much more difficult to agree at the national level. Here, a number of bills have been proposed by different Representatives of Parliament since 2007 without finding the necessary majority and approval so far (as of January 2011). In the EU, discussions at the academic level have started again regarding the possibility, including advantages and disadvantages, of an Ecosystem Services Directive. Apart from technical legal questions, such as whether to build an umbrella directive compiling and streamlining all existing directives, or to develop an additional 'stand-alone' directive, the key question addresses the effectiveness and efficiency of this approach. In other words, it still has to be proven that such an Ecosystem Services Directive has the real potential to promote nature conservation instead of creating a legal and bureaucratic 'monster', which could abolish the considerable progress made so far through sectoral ecosystem-related legislation.

Eventually, specific PES laws should be harmonised and integrated with existing legal and institutional frameworks

If a specific PES law was created, special attention would need to be paid to its integration in the existing legal and institutional frameworks, in particular those sectoral laws that already regulate the different ecosystems.

SECTORAL ENVIRONMENTAL LEGISLATION

An alternative to the development of a specific PES law is the amendment of pre-existing sectoral environmental legislation. Introducing specific PES provisions through such amendments requires less legal drafting and synchronisation work and it provides an opportunity to clarify or further develop existing economic instruments. For example, in Brazil again, the 1997 Water Law (Law No. 9433) foresees under Article 5 that charges for water utilisation can be applied. Such water usage fees are already collected in residential, commercial, public and industrial sectors. However, they are mainly imposed to fund water infrastructure, operations and maintenance. The allocation of these funds to support water-related PES schemes is yet to be put in practice (Valladares, 2009).

An alternative to the development of a specific PES law is the amendment of pre-existing sectoral environmental legislation

In the European Union, as another example, one key element of the Water Framework Directive (Directive 2000/60/EC) and its river basin management planning process is the requirement for an economic analysis (Article 5.1. and Annex III). Such economic analyses shall assess current levels of recovery of the costs of water services: this concerns water service provision and the extent to which financial, environmental and resource costs are recovered, how cost recovery is organized and the way in which key water users contribute to the cost of water services. However, in order to tap the full potential of the Water Framework Directive for the development of PES schemes, it needs to be clarified that ecosystem services should be used for the achievement of environmental objectives and, therefore, need to be considered by the economic analysis and in river basin management decisions. Furthermore, it needs to be clarified that ecosystem services are 'water services', as defined in Article 2 (38) of the Water Framework Directive and, therefore, part of the principle of full cost recovery.

Table 11 provides an excerpt of the possible content of PES regulatory provisions.

Indirectly relevant laws[3]

An enabling legal framework for PES schemes requires compatibility with indirectly relevant laws. Such indirectly relevant laws need to be carefully assessed as they may introduce perverse incentives which clash with the objectives of PES. At the same time, these laws might also include certain provisions with a great potential to support PES initiatives. In Colombia, Law No. 99 of 1993 requires the investment of a certain amount of money coming from water-use projects, the energy sector or irrigation districts into watershed conservation activities. Such mandatory investments, thus, provide a potential source of funding for PES projects (Navarrete Le Bas, 2009).

Indirectly, relevant laws may support perverse incentives that clash with PES programmes

CHALLENGES LINKED TO THE IMPLEMENTATION OF PES SCHEMES

One of the greatest challenges in the development of PES initiatives can be related to the issue of property rights. Property rights are crucial in the context of PES for different reasons: contracting parties are generally free to decide upon the object of a PES contract. As a consequence, they can agree that payments should be made for a specific ecosystem service, or more likely for a particular land-use/management practice. In both cases, property rights questions come into play. In the latter case, the contracting party must have sufficient property rights, i.e. the necessary control and/or use rights which allow him to legally fulfil the obligations of the contract.

In the first case, the party obliged to provide an ecosystem service should also have the right to sell the particular ecosystem service. As the right over a natural resource (e.g. a tree) and the right over an ecosystem service provided by this natural resource (e.g. storing carbon)

3 Indirectly relevant laws are those related to natural resources management in general or financial issues, such as land laws, agricultural laws, mining laws, planning or land development laws, fiscal laws, etc.

Table 11
Possible content of a comprehensive legal framework for PES

Type of regulation	Content
General regulations	❈ Definition of purpose and scope of PES ❈ Terminology: ecosystem services vs. environmental services; different types of ecosystem services; different types of PES ❈ Cross-cutting issues
Financing regulations	❈ PES funding sources ❈ Percentages to be dedicated to PES ❈ Establishment of specific funds/accounts
Institutional regulations	❈ Supporting project development (e.g. scientific support) ❈ Fundraising (e.g. collecting and managing funds) ❈ Management (e.g. access to information, participation, etc.) ❈ Monitoring compliance ❈ Enforcement of laws and PES contracts
Implementing regulations	❈ Application requirements ❈ Contractual issues ❈ Property and tenure issues ❈ Additionality requirements ❈ Safeguards for benefit-sharing ❈ Land-use planning ❈ Compliance and enforcement

can differ and belong to different people or entities, it can be important to create legal certainty by clarifying the property rights over ecosystem services in the national legislation.

The 2009 Bolivian Constitution recognises private property rights over land, but it is not absolutely clear whether this also extends to 'all' the natural resources above the land, i.e. the Constitution expressly states that it does not recognise private property over 'other' natural resources. For those, people can only be granted use rights. The question therefore is whether such 'other natural resources' only refer to non-renewable natural resources, like oil and gas, or if this limitation of property rights also applies to renewable natural resources, including their ecosystem services. Such legal insecurity regarding the rights over ecosystem services has the potential to hamper the development of PES schemes (Wichtendahl, 2009).

In Peru, for example, according to the 1993 Constitution, all natural resources are the natural heritage of the nation which, according to the Organic Law for Sustainable Management of Natural Resources, is managed by the state. The 2008 Forestry Law provides different instruments to grant rights over forest resources to individuals, such as through different types of concessions to use the timber and/or the non-timber goods, to use the forest land for ecotourism purposes, etc. After a concession is granted, a management plan has to be developed (subject to the approval by the Forestry Division of the Ministry of Agriculture), which has to indicate all the planned activities on the forest land. While the Forestry Law clarifies that the holder of a timber concession can include PES activities in his management plan so that he can sell the forest-related ecosystem services, it lacks such clarification with regard to other types of forest concessions. As a consequence, the holder of an ecotourism concession does not have the explicit right to sell, for example, the carbon-related ecosystem services provided by the forest which is subject to his concession. This limits the possibilities of such concession holders to bundle services and participate in PES (Sandoval and Capella, 2009).

Furthermore, payments to landowners or users will be a source of conflict if property rights are disputed. There are different potential sources of conflict over property rights, including clashes between statutory and customary law. While statutory law is the written or codified law of a country, customary law refers to traditional rules and norms that may exist at a very local level and for specific groups of people. A conflict arises, if the regulation of property rights according to customary law is not legally recognised by the statutory law, though still applied in practice. Further disputes may exist over property rights legislation. As mentioned before, in many countries, property rights over ecosystem services are not yet defined by law and are, therefore, controversial. In addition, it is sometimes not entirely clear, if existing property rights will still be recognised if the land and/or the natural resources are not utilised, but 'only' conserved in the future.

Property rights are often uncertain due to a conflict between statutory and customary laws

In several countries, such as Bolivia, agricultural legislation aims at redistributing and clarifying land rights (Wichtendahl, 2009). At the same time, however, incentives are created that lead to further deforestation. The Bolivian National Service of Agricultural Reform Law (INRA Law No. 1715) has the objective to redistribute land and to carry out the land's regularisation process. It conditions the maintenance of the property right over rural lands to their so called 'socio-economic function'. The previous constitution of Bolivia (a new constitution was enacted on 7 February 2009), which considered natural resources as purely economic goods, giving priority to extractive and industrial uses over conservation activities, led to a misconception of this socio-economic function requirement of the land. It created the general understanding that the maintenance and acquisition of rural lands was linked to active work, meaning deforestation. Such an understanding, of course, clashes with the core objective of forest-related PES schemes.

Ambiguous property rights registration on the ground might pose an additional problem. Uncertainty regarding property rights titles may occur, if their granting is subject to a complicated, costly or bureaucratic process.

Even if a formal title exists, the precise size and borders of the respective land might be still unclear sometimes. Such insecure tenure is often directly related to over-exploitation of natural resources and degradation of ecosystem services. Without appropriate property rights regulations, the prospect of joining a PES initiative and get paid may attract increased numbers of resource users to an area.

Finally, attempting PES initiatives without adequately addressing inadequate land tenure could even exacerbate existing wealth and power imbalances in a given society. Where tenure is weak, complicated or conflicts exist between statutory and customary law systems, wealthier 'elite' members of society may monopolise payments. In many areas of Africa and Asia and in indigenous communities of Latin America, traditional tenure systems may vest rights in entire communities or in multiple users via hierarchies of overlapping rights. Such systems can pose a challenge for PES systems modelled on Western-style property systems based on title vesting in a single owner with official title to a well-defined area of land. Should developing country PES systems not adjust for non-Western tenure systems, poorer elements lacking access to information, connections or financing for upfront costs to register their lands could lose the ability to participate in PES initiatives.

The above challenges require flexible solutions in the development of PES initiatives. Amongst others, such solutions could include:

- Referring not only to land or natural resources ownership as a PES requirement, but also **allowing for participation of holders of use rights**;
- Taking advantage of ongoing registration processes, but **not making registration a prerequisite for participation in PES**;
- Accepting alternative ways for establishing property rights, such as **recognising so-called 'de facto' rights** (i.e. opportunity to prove that the land was peacefully held for a considerable period of time);
- **Allowing for informal land registration**, rather than only formal cadastral and land titling systems, which generally take too long to be worthwhile for PES initiatives;
- **Making payments in the form of in-kind municipal services** benefiting locals generally without the need for property ownership determinations, where PES programmes depend on the engagement of entire communities.

There can be many flexible solutions to resolve property rights issues that might adapt to different levels of legal certainty and convenience found in different contexts where PES are implemented (Figure 30). The following diagram explains the differences in legal certainty and convenience when developing PES initiatives.

FUTURE CHALLENGES: THE IMPORTANCE OF SUSTAINABLE DEVELOPMENT PLANNING

Another challenge in the future development of PES schemes will be the creation of an enabling legal environment, which can stimulate a more efficient use of PES financial resources and promote the integration of different PES or ecosystem services related activities. For example, although designed to limit harmful climate change, REDD has the potential to provide additional ecosystem services, such as the conservation of biodiversity. Yet, without specific consideration of other ecosystem services, REDD is likely to protect only forests that are most cost-effective for reducing carbon emissions. At the same time, REDD schemes or other PES projects have the potential to compliment and/or strengthen other ecosystem related conservation activities, such as the designation of protected areas or ecosystem-based adaptation projects.

Enabling legal environments promote integration and bundling of ecosystem services and more efficient use of financial resources

Thus, the question is how to ensure a balanced approach in the development of PES initiatives. Appropriate laws and regulations need to build a comprehensive framework which will:

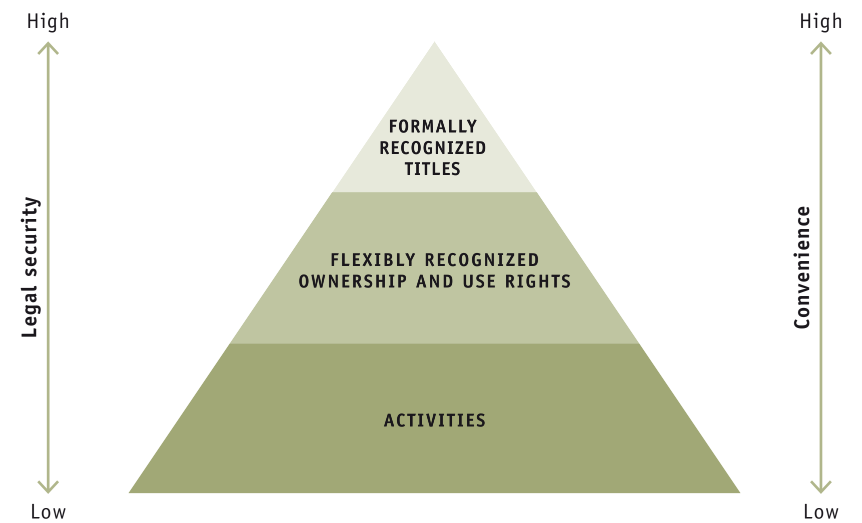
- **Promote a holistic ecosystem services approach**;
- **Facilitate efficient bundling of different types of PES at different scales**, as well as other policy instruments focusing on ecosystem conservation (such as protected areas or ecosystem-based adaptation projects);
- **Strengthen the ecosystem services approach in different planning processes** (from land-use planning and spatial planning to environmental impact assessments and strategic environmental assessments);
- **Adjust institutional frameworks to improve governance of ecosystem services** across sectors and across administrative boundaries.

In particular, sustainable development planning has a huge potential to facilitate cross-sectoral ecosystem considerations and, thus, to integrate and harmonise different ecosystem services related activities, such as climate change mitigation projects, adaptation activities, biodiversity and watershed-related PES schemes, designation of protected areas, etc. In this context, it will be crucial to create a legal framework, which not only balances infrastructural and economic development priorities with ecosystem services concerns, but also prioritises ecosystem services according to clear rules and indicators and provides for permitting processes including trigger clauses which can re-open and re-evaluate land-use decisions.

Figure 31 indicates the cost-efficiency of PES and other conservation-related activities with or without sustainable development planning.

Figure 30

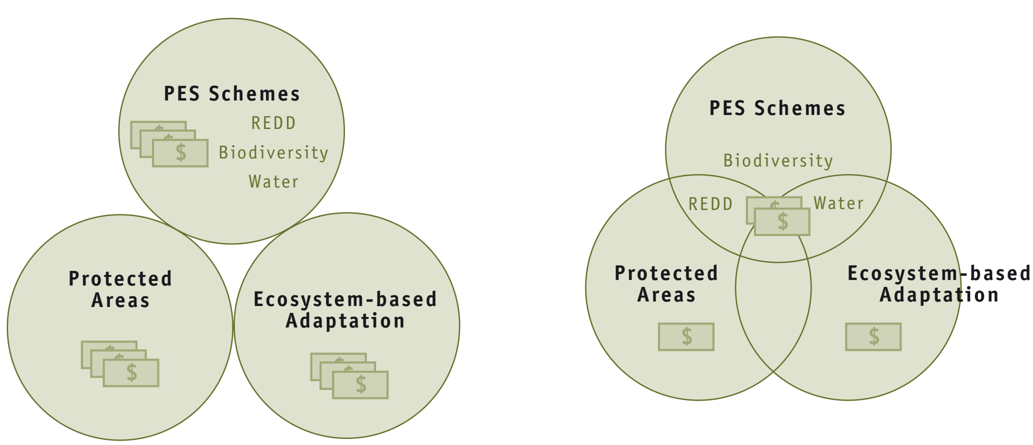
Pros and cons of taking a flexible approach when solving property rights issues



Adapted from Greiber, 2009

Figure 31

Cost-efficiency with or without sustainable development planning



CONCLUSIONS

The above discussion gives an overview of the importance of legal frameworks for the development of PES initiatives. For the further promotion of PES, it is crucial to properly take into account the challenges linked to the setting up of legal frameworks for such schemes and to consider guidance on their development. Such guidance is necessary when choosing the appropriate legal instrument(s) for PES promotion (constitution, PES law, sectoral legislation, etc.), the basic content of these instruments or their right scope. Ensuring such adequacy also implies taking into account and responding to potential challenges on the ground, for example, issues related to good governance in general or property rights in particular. Finally, the further promotion of PES will also depend on the development and utilisation of land-use planning instruments. Such instruments will be crucial to ensure bundling and integration of existing PES initiatives in order to secure efficient financing and effective provision of different ecosystem services.

REFERENCES

Angelsen, A. & Wertz-Kanounnikoff, S. 2008. What are the key design issues for REDD and the criteria for assessing options. *In* A. Angelsen, ed. *Moving ahead with REDD: Issues, options and implications*. Bogor, Center for International Forest Research (CIFOR).

Costenbader, J., ed. 2009. *Legal frameworks for REDD. Design and implementation at the national level*. Gland, IUCN-The World Conservation Union.

Greiber, T., ed. 2009. *Payments for ecosystem services. Legal and institutional frameworks*. Gland, IUCN-The World Conservation Union.

Gutman, P. 2007. Ecosystem services: Foundation for a new rural-urban compact. *Ecological Economics*, 62: 383–387.

MEA. 2005. *Ecosystems and human well-being: A framework for assessment*. Washington, D.C., Island Press.

Navarrete Le Bas, F. 2009. Annex III: Colombia Report. *In* T. Greiber, ed. *Payments for ecosystem services. Legal and institutional frameworks*. Gland, IUCN-The World Conservation Union.

Perrot-Maître, D. 2006. *The Vittel payments for ecosystem services: A "perfect" PES case?* London, International Institute for Environment and Development (IIED).

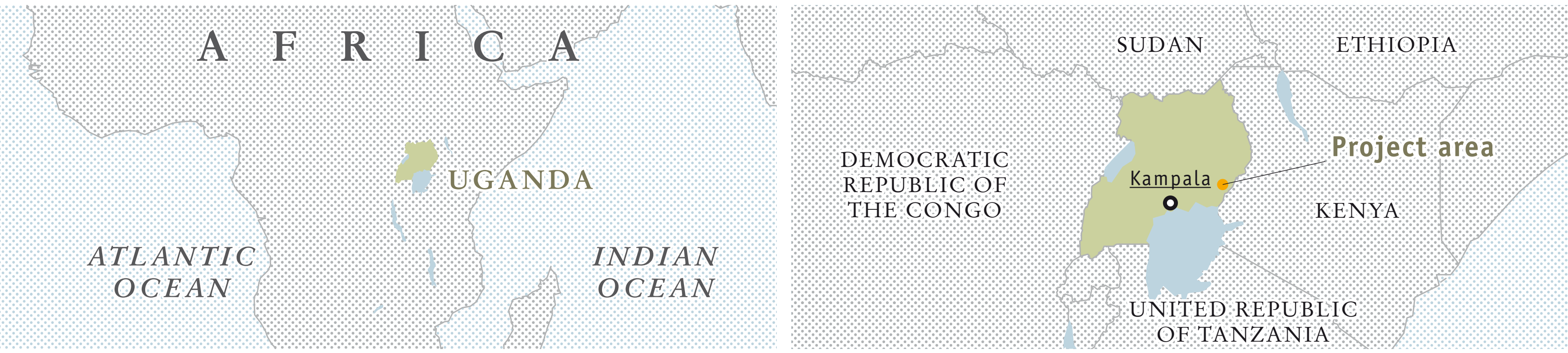
Sandoval, M. & Capella, J. 2009. Annex IV: Peru Report. *In* T. Greiber, ed. *Payments for ecosystem services. Legal and institutional frameworks*. Gland, IUCN-The World Conservation Union.

Valladares, R.E. 2009. Annex I: Brazil Report. *In* T. Greiber, ed. *Payments for ecosystem services. Legal and institutional frameworks*. Gland, IUCN-The World Conservation Union.

Wichtendahl, C.G. 2009. Annex II: Bolivia Report. *In* T. Greiber, ed. *Payments for ecosystem services. Legal and institutional frameworks*. Gland, IUCN-The World Conservation Union.

PLAN VIVO: A VOLUNTARY CARBON SEQUESTRATION PES SCHEME IN BUSHENYI DISTRICT, UGANDA

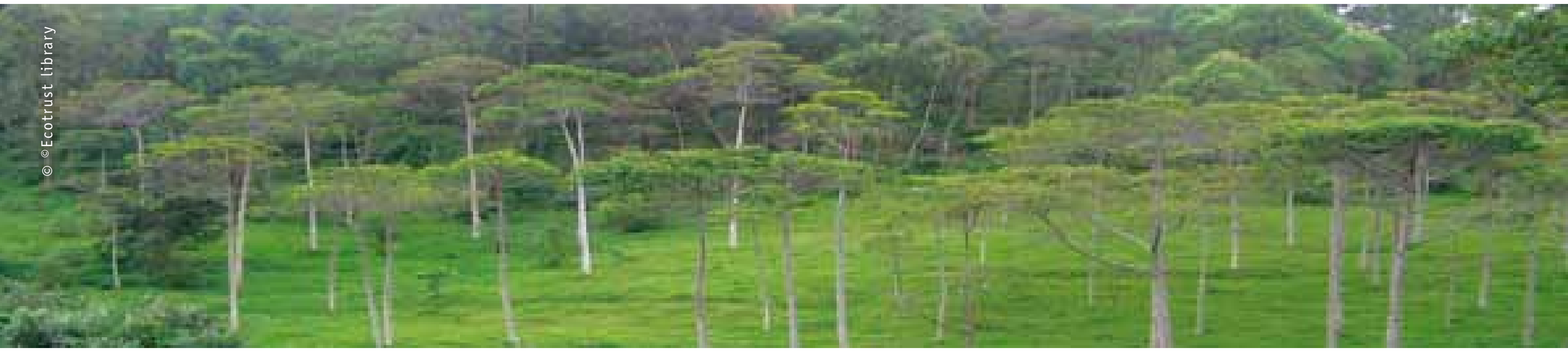
Elisa Distefano
Food and Agriculture Organization of the United Nations, Rome, Italy



Uganda does not have legally-binding targets to reduce or limit its GHG emissions during the Kyoto Protocol's first commitment period (2008-2012); however, the country should take advantage of the emerging carbon markets to attract international investment and join the international community in mitigating emissions. High priority should be given to those mitigation options that bring direct socio-economic benefit and are in line with the national policy on poverty eradication and sustainable development (UNFCCC, 2002). Indeed, one of the strategies proposed in the Uganda National Forestry Plan (2002) to increase investment in the forest sector is the implementation of carbon sequestration projects. This case study illustrates a carbon sequestration project implemented in Bushenyi district, Uganda.

The Plan Vivo Foundation developed a system for managing community-based land-use projects that result in long-term carbon storage and generate livelihood and ecosystem benefits. Project participants are smallholders and forest-dependent communities in developing countries. Currently, the Foundation has registered projects in Mexico, Mozambique, Nicaragua, Tanzania and Uganda. The Plan Vivo System works through projects by following four key steps: (a) project design, (b) definition of a land-management plan (i.e. Plan Vivo), (c) establishment of sales and agreements, and (d) monitoring and payments. Plan Vivo works with local NGOs that function as project developers and coordinators.

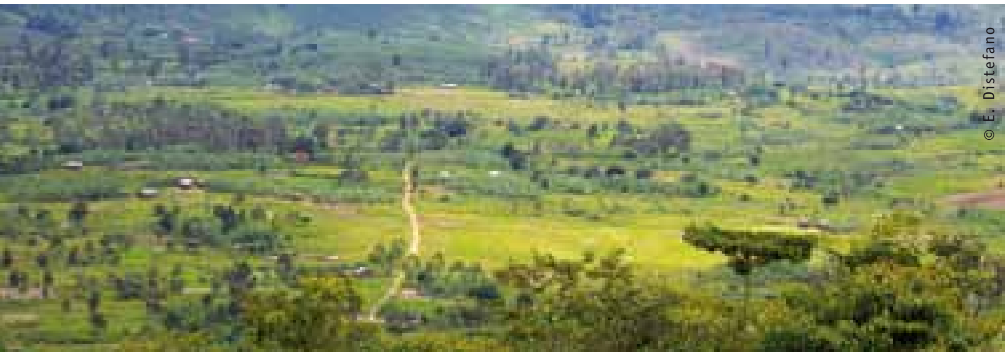
In the first phase, communities decide through participatory consultations which land-use activities (e.g. afforestation, reforestation, agroforestry, forest conservation) will best address threats to the local ecosystems and reflect their own needs, priorities and capabilities. In the second phase, each farmer writes his/her own plan vivo, which is essentially an annotated map showing which species will be planted, where and how many (Figure 32). Each plan vivo is evaluated by the project coordinator for its technical feasibility, social and environmental impact


© ©Ecotrust library

and carbon sequestration potential, according to approved technical specifications developed by internationally recognised research institutions, such as the University of Edinburgh, the World Agroforestry Centre (ICRAF) and the Edinburgh Centre for Carbon Management (ECCM). In the third phase, farmers or farmer groups enter into sales agreements with the project coordinator, who agrees to make staged payments and provide continued technical support and training. As the farmers implement the activities according to their plan vivos, the project coordinator monitors whether the targets are met and makes the payments accordingly. The emissions reductions are sold on behalf of the farmers or community in the form of carbon offset certificates.

The implementation of the Plan Vivo System in Uganda is managed by Ecotrust, a local conservation NGO in the Bushenyi District. This administrative unit is a patchwork of subsistence farms planted with bananas, corn, coffee, sugarcane, sweet potatoes and other crops (Figure 33). The key objective of the project is to enable communities of farmers to access the emerging voluntary carbon market by combining carbon sequestration with sustainable rural development. A group of carbon buyers[1] supports the project; they were informed about the possibility of purchasing carbon offset certificates through resellers and brokers, such as the Carbon Neutral Company, U&W in Sweden, Climate Path in the USA, Climate Action in China, Plan Vivo and Ecotrust websites and through their occasional presence at international conferences. Around 500 farmers joined the project and were informed about carbon sequestration and trading through workshops and training events. Farmers are advised to plant according to three systems: boundary planting, agroforestry or woodlot planting. Forest technicians also guide farmers in designing their plan vivos and provide training in good silvicultural practices during the various stages of implementation.

1 DFID, Tetra Pak UK Ltd., the Carbon Neutral Company, the International Network for the Availability of Scientific Publications (INASP), the Katoomba Group and others.



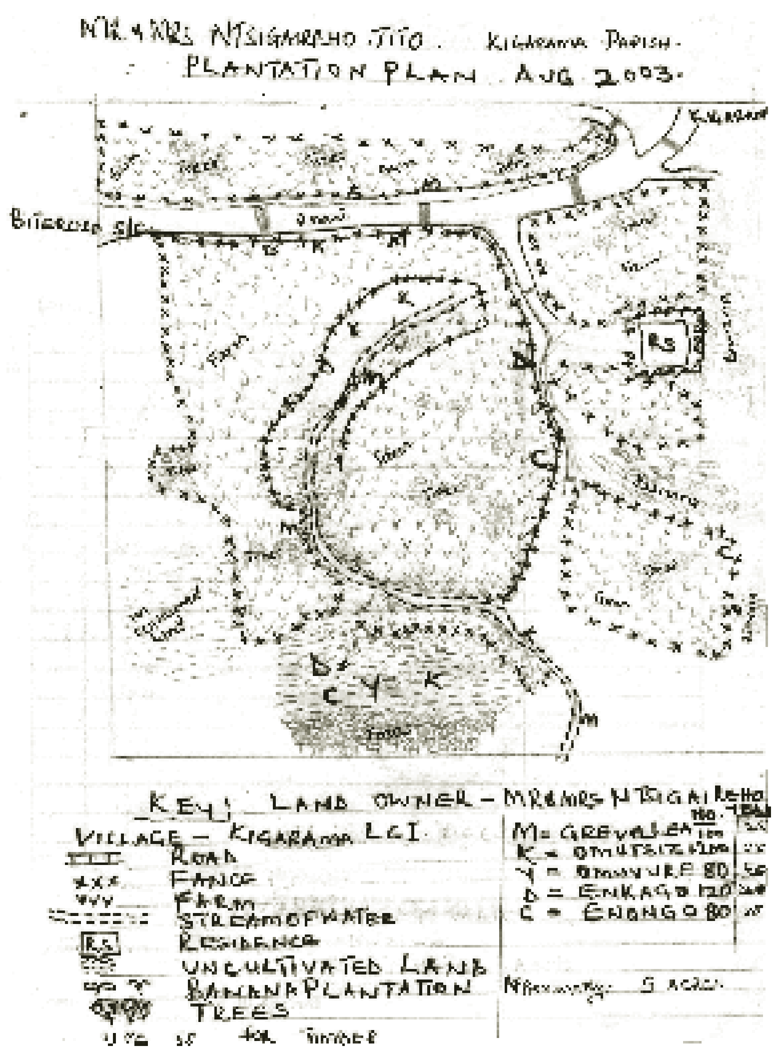
Current pages (from left to right):

→ Under a Plan Vivo project, carbon can be sequestered and certified through afforestation, reforestation, agroforestry and forest conservation activities.

→ Mosaic of small fields and forest patches in Bushenyi district.

Figure 32

Example of a plan vivo made with a farmer for agroforestry and reforestation on his farm



Source: ECOTRUST, 2004

The technical specifications developed for this project are woodlots of *Maesopsis emini* and mixed native species woodlots composed of *Prunus africana* and *Grevillea* spp., among others. One hectare planted with 400 trees sequesters 226 tonnes of carbon dioxide over 25-50 years, depending on the farming systems (e.g. 25 years for a woodlot of *Measopsis* spp. and/or 50 years for mixed native species woodlots). These land-use systems were chosen because *Maesopsis* spp. is a native tree found in tropical ecosystems of East, Central and West Africa, is one of the fastest growing timber trees in the country and can thrive in a wide range of rainfall and altitudinal conditions. Other features, such as germplasm availability, ease of propagation, compatibility with most agricultural crops and superior timber products make the species suitable for tree planting. The primary objective of the woodlot system is to produce high-quality timber at the end of established rotations, as well as fuelwood obtained through thinning and pruning. The technical specifications take into account that the removed branches are used to produce charcoal and that the combustion of the wood will release a part of the carbon sequestered. To avoid a situation in which planting trees on agricultural land leads to further deforestation as farmers encroach on forests to cultivate crops, the plan vivos are approved only if farmers can set aside a minimum of one hectare for tree planting. Farmers now manage 692 ha of land for an emission reduction capacity of 80 000 tonnes of carbon dioxide per annum. The project has been validated and verified by a third independent party: the Rainforest Alliance.

The Plan Vivo System ensures that an average of 60 percent of the carbon offset purchase income goes directly to communities through instalments disbursed over a decade. Payments are released according to specific time-bound targets: (a) percentage of the plot planted (in years 0 and 1), (b) survival rate (in year 3), and (c) growth rate (in years 5 and 10). The payments to farmers or the community are released through microfinance institutions located in the villages. It has been estimated that the average number of trees planted on farms is 600, thus farmers receive on average of USD 900 over ten years.

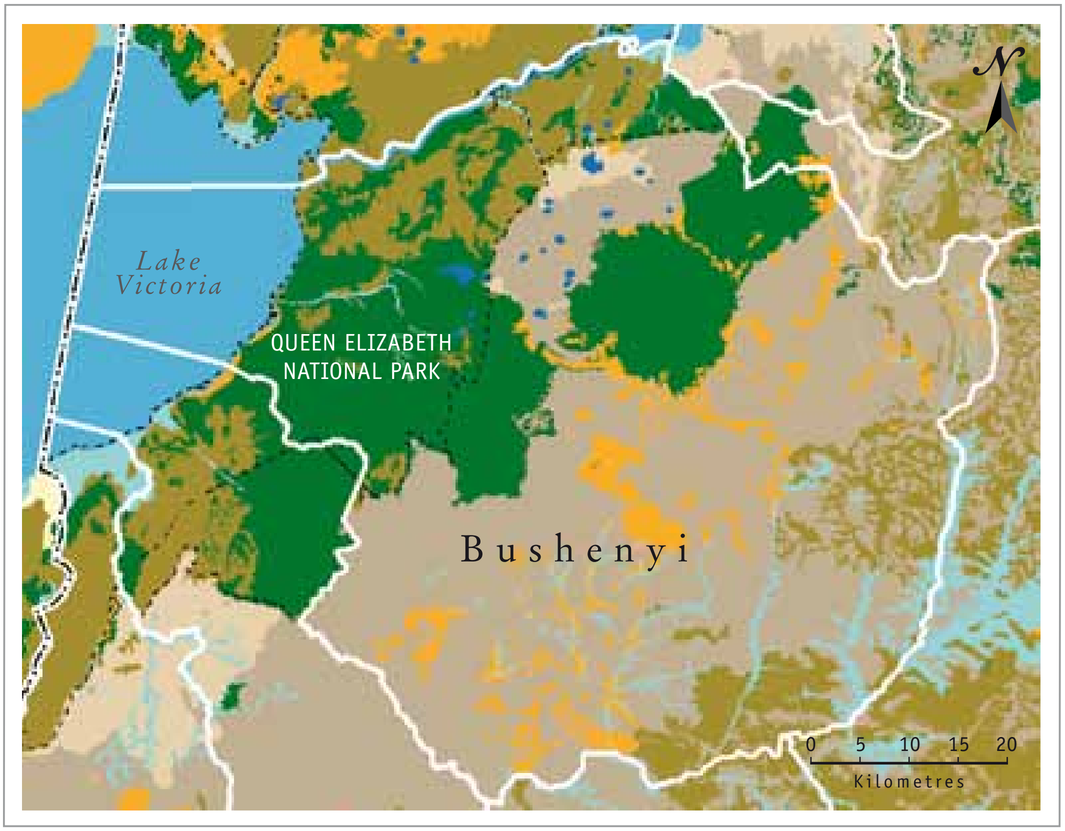
Current pages (from left to right):

→ Engaging the community in the activities of a Plan Vivo project.

→ Participatory resource assessment, which is part of the Plan Vivo project introduction process.

→ Participatory consultation of the communities on possible suitable land use that will increase carbon sequestration, while taking into account local farming priorities and household needs.

Figure 33
Land cover of Bushenyi district in 2000-2001



LEGEND

- Forest plantation and tree plantation
- Shrub crop
- Herbaceous crop
- Forest, woodland and woody vegetation
- Thicket and shrubland
- Savannah and grassland
- Vegetation on flooded land
- Bare soil and sparse vegetation
- Artificial surface
- country boundary
- district boundary
- park boundary

Adapted from Cecchi *et al.*, 2008. *Source*: Africover (http://www.africover.org)


© FAO/R. Faidutti

This amount is not negligible, considering that farmers in the Bushenyi district live on about two dollars a day (USD 720 per year). The project will thus result in increasing farmers' income but, most importantly, it will result in increased productivity and food security as a result of improved understanding of agroforestry principles and land management techniques. Short-term benefits include the opportunity of improved availability of medicinal and non-timber forest products, such as extracts from some indigenous trees, e.g. *Prunus africana*, fruits, fodder, manure, fuelwood from branches and support for honey production. Farmers also receive training and capacity-building in tree planting and agroforestry.

Long-term benefits are watershed protection and the reduction of flooding risk as water enters river systems with decreased speeds in the catchments area of Lake Victoria, as well as the restoration of environmental and ecological functioning in heavily degraded areas. Such functions include runoff and soil erosion control, microclimatic stabilisation and increased terrestrial biodiversity, e.g. birds. Some farmers are using *Maesopsis* to provide shade in coffee and banana plantations. There is evidence that shaded coffee grown in the proper conditions yields better and is of superior quality to conventional unshaded coffee. Other benefits are expected to derive from the sale of high-quality timber harvested at the end of the rotational period. The timber extracted by 400 trees is expected to be worth at least 80 million Ugandan shillings (equivalent to USD 48 600) for species such as *Maesopsis eminii*.

Conservation and community benefits seem high, yet standards of this type usually remain small because they are very costly compared to cheap carbon options available on a globally traded carbon market. The costs of generating one tonne of carbon dioxide through the Plan Vivo system in Uganda is approximately USD 6. Table 12 provides an analysis of the overall costs by tonnes of carbon dioxide sequestered. One of the main constraints on scaling up the project in Uganda is the lack of buyers. In addition, this system sells carbon offsets that are projected to be produced in the future (ex-ante credits), although these credits cannot guarantee that actual emissions reductions will be realized.

Current pages (from left to right):

→ Bamboo forests in Uganda can be considered a multipurpose crop and being one of the fastest-growing plants on earth, bamboo has a high potential for carbon sequestration.

→ Women's participation can be hampered by local perceptions about gender roles and rights, but focus groups led by Plan Vivo aim to narrow this gender gap.

Table 12
Costs of generating one tonne of carbon dioxide

Payment to farmers (60%)
Certification costs (certificate issuance including registry) (6%)
Verification costs (4%)
Administrative, community engagement and recruitment, local technical assistance and monitoring (30%)

REFERENCES

BR&D (BioClimate Research and Development). 2008. *The Plan Vivo systems and standards*. Edinburgh, BR&D.

Cecchi, G., Mattioli, R.C., Slingenbergh, J., de la Rocque, S. & Feldmann, U. 2008. *Standardizing land cover mapping for tsetse and trypanosomiasis decision making*. Programme Against African Trypanosomiasis Technical and Scientific Series, No. 8. Rome, FAO (available at ftp://ftp.fao.org/docrep/fao/010/i0215e/i0215e.pdf).

Ecotrust. 2004. *A Plan Vivo carbon offset project with small-scale farmers in Bushenyi district. Annual Progress Report 2003/2004. Appendix 1* (available at http://planvivo.org.34spreview.com/wp-content/uploads/TGB-annual-report-2004.pdf).

Kairu, G. & McGhee, W. 2006. *Bushenyi field trip report, Uganda. Trees for global benefit: A Plan Vivo project*. BR&D and Ecotrust.

Plan Vivo website. Available at http://www.planvivo.org.

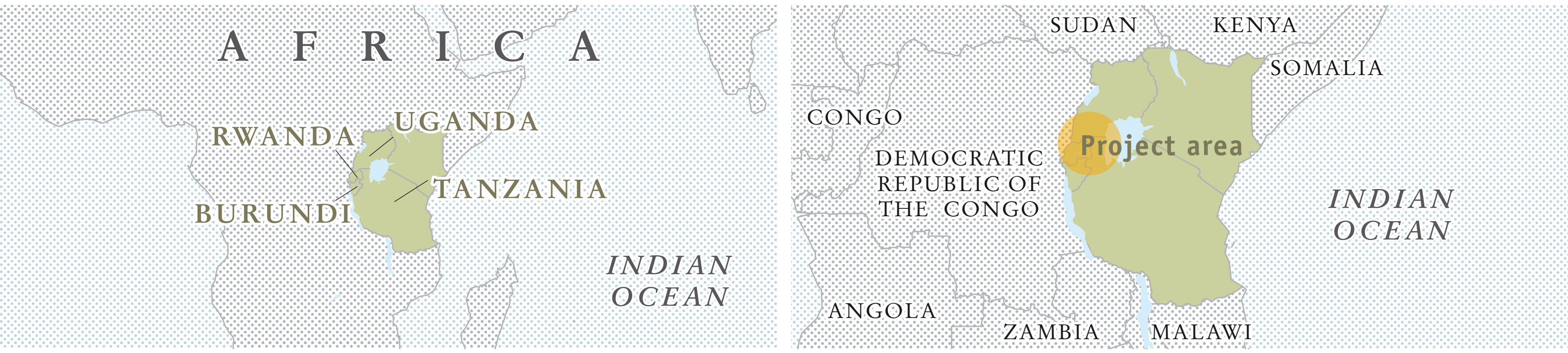
Republic of Uganda. 2002. *UNFCCC Uganda national communication*. New York and Nairobi, The GEF, UNDP, UNEP.

UNFCCC. 2002. *National communications: Uganda. United Nations Framework Convention on Climate Change* (available at http://unfccc.int/national_reports/non-annex_i_natcom /items/2979.php).

WWF. 2008. *Making sense of the voluntary carbon market: A comparison of carbon offset standards*. Stockholm, Stockholm Environment Institute (SEI) and Tricorona.

PES AND THE KAGERA TRANSBOUNDARY AGRO-ECOSYSTEMS MANAGEMENT PROJECT, EASTERN AFRICA

Jean Gault, Davina Berttram and Sally Bunning
Food and Agriculture Organization of the United Nations, Rome, Italy



The Kagera River basin is located in East Africa and is shared by four countries: Burundi, Rwanda, Tanzania and Uganda (Figure 34). The basin covers a surface area of 59 700 km^2 and occupies a strategic position in the region, contributing to almost a quarter of the inflow into Lake Victoria. The basin's agro-ecosystems are facing increasing pressure as a result of rapid population growth, agricultural and livestock intensification characterised by progressive reduction in farm sizes, and unsustainable land-use and management practices. The land and freshwater resource base, and associated biodiversity and populations' livelihoods and food security are threatened by land degradation, declining productive capacity of croplands and rangelands, deforestation and encroachment of agriculture into wetlands. Climate change and variability aggravates these threats.

The Kagera Transboundary Agro-ecosystems Management Project (Kagera TAMP)[1] was launched to adopt an integrated ecosystems approach for the management of land resources, aiming to generate local, national and global benefits, including: restoration of degraded land, carbon sequestration, climate change adaptation and mitigation, protection of international waters, agro-biodiversity conservation, sustainable and improved agricultural production, and increased food security and improved rural livelihoods.

1 http://www.fao.org/nr/kagera/en/

Figure 34

Kagera basin and TAMP project areas

LEGEND

- basin boundary
- country boundary
- administrative boundary

Project areas

- Uganda
- Rwanda
- Burundi
- Tanzania

Adapted from original map by Monica Petri (FAO)

© S. Schlingloff

**Current pages
(from left to right):**

→ Lowland section of the Kagera River Basin, which covers an area of about 60 000 km^2 extending across Burundi, Rwanda, Tanzania and Uganda.

→ The Kagera River is the largest incoming river of Lake Victoria, providing a quarter of its inflow, but also carries high quantities of soil sediment and nutrients washed from the land.

→ The Kagera Project (TAMP) works with a range of stakeholders and aims at increased food and livelihood security through integrated natural resource and ecosystem management.

The Kagera TAMP has four central components paying attention to gender issues, resource access and conflict resolution:

a. Enhanced regional collaboration, information sharing and monitoring;
b. Enabling policy, planning and legislative conditions;
c. Increased stakeholder capacity and knowledge at all levels for promoting integrated agro-ecosystems management;
d. Adoption of improved land-use systems and management practices generating improved livelihoods and ecosystem services.

Within the Kagera TAMP project area, there are two ongoing PES initiatives: the Small Group and Tree Planting Project in Uganda and the Emiti Nibwo Bulora Project in Tanzania.

The PES scheme carried out by the Emiti Nibwo Bulora Project (Tanzania) in the Bugene and Kaisho zones, located in the Karagwe district and within the Kagera province (Tanzania), is focused on rewarding farmers for carbon sequestration in soil and perennial plants achieved through agroforestry and agronomic practices. This initiative is being promoted by the Swedish Cooperative Centre (SCC) together with the Swedish Vi Agroforestry Programme (ViAFP), which, as from January 2006, are integrated into one regional organization, SCC-Vi Eastern Africa. The Emiti Nibwo Bulora Project also involves Plan Vivo which independently assesses the reduction of carbon emissions and generates Plan Vivo certificates that are sold exclusively on the voluntary market. This project was initiated in 2008 and the first carbon reduction certification was carried out by Plan Vivo in 2010. The PES agreement for carbon sequestration requires improved soil management and agroforestry systems. Farmers design their personal management plan, including boundary planting, woodlots, fruit orchards and dispersed inter-planting. Grazing and tree-cutting during the contract period is not allowed.

© FAO/J. Burgess

© FAO/J. Burgess

Currently, the project covers an area of 15.9 ha with 23 small-scale farmers participating with individual landholdings of between 0.06 and 1 ha. All participants are males due to the land ownership structures, yet the project is considered to contribute on the household level and gender mainstreaming is taken into account in the process.

Payments to participants are in cash, distributed over five instalments (in the 1st, 2nd, 3rd, 5th and 10th years) during the 10-year contracts. In total, the pilot group will receive Tsh. 11 166 000 (equivalent to USD 7 360) in the contract phase. The first payment was in June 2010, according to the Plan Vivo offset standard system. In total, 14 farmers have qualified for the first payment, amounting in total to Tsh. 1 848 400 (equivalent to USD 1 218). In order to qualify for payments, farmers must have fulfilled a certain percentage of their individual management plans. Payments depend on the individual participants' land-use management plans and technical specifications for carbon sequestration, based on the adopted technologies. The buyer at this pilot stage is the Vi Agroforestry Programme, yet private companies (primarily in Sweden) are the target group in the future, also for potential internal upscaling of the project.

The total emissions reduction capacity of the project is estimated to be 40 000 tonnes of carbon dioxide per year. Annual monitoring is planned measuring the annual (stem) volume increments (m^3 per year) of trees, as well as adopted land-use changes by participants. The PES scheme is also embedded within a larger regional land management project, the Lake Victoria Regional Environmental and Sustainable Agricultural Productivity Programme (RESAPP). This programme features components on sustainable land management, capacity building, organizing farmers into strong farmer groups, encouraging enterprises (e.g. beekeeping, fish farming, wine production) and promoting a savings and loan scheme based on farmer groups.


© FAO/J. Burgess

Current pages (from left to right):

→ The Kagera basin supports over 16 million people, whose livelihoods are threatened by population growth, agricultural intensification and unsustainable land practices.

→ Rwandan farmers at a Farmer Field School, a participatory empowerment and learning approach by Kagera TAMP for promoting sustainable agro-ecosystem management.

→ The initial phase of PES for carbon sequestration involves capacity building for nursery establishment and tree planting and management.

Targeted co-effects of the scheme are: soil conservation through higher organic matter content, improved water management (infiltration and soil retention) and water quality (less erosion and siltation), capacity development, and enhanced resilience to climate variability and change. Economic benefits will be based on: (a) increased yields and productivity, and (b) additional income sources due to payment for ecosystem services. The central principles applied in the scheme are participatory community engagement in the whole development process, transparency, acceptance of customary ownership of land and close cooperation with the local and district office of the Ministry of Natural Resources.

One of the major advantages of this project is its long-term duration; many lessons are to be learned and a significant benefit is expected for the conservation of the ecosystem and the improvement of livelihoods of local people.

CHAPTER

8

PES WITHIN THE CONTEXT OF GREEN ECONOMY

Daniela Ottaviani and Nadia Scialabba
Food and Agriculture Organization of the United Nations, Rome, Italy

CONTENTS

ABSTRACT

The term 'green economy', while being a debatable concept, is high on the agenda of the UN Conference on Sustainable Development (UNCSD) that will be held in Rio de Janeiro (Brazil) in 2012. The transition towards a green economy will require several integrated actions; a possible theoretical framework for a green growth strategy lead by the public sector is hereby proposed. As a first level of intervention, the public sector is expected to set suitable enabling conditions in terms of legislation, education and research. As a second level of intervention, the public sector should level prices and shape opportunity costs of green economy initiatives by (re)designing incentives and removing/reforming harmful subsidies. Within such a level of market intervention, the public sector is also expected to make direct investments to propel a green economy and enter the market as a buyer through public procurement, labelling, price premiums and Payments for Ecosystem Services (PES). By considering the elements of this framework in depth, it becomes clear that this same theoretical framework also applies to the enabling conditions and the market interventions needed to implement successful PES schemes. The occurrence of so much correspondence between favourable conditions for a green economy and for the implementation of successful PES schemes suggests that PES schemes can be local small-scale field tests of a wider global green economy.

INTRODUCTION

The concept of a 'green economy' has lately gained currency as the world has been searching for solutions to multiple global changes, especially in the midst of the global economic crisis of 2008. The UN Joint Crisis Initiative 4 (JCI-4), led by the United Nations Environment Programme (UNEP), published the *Green Economy Report*, covering all sectors' contributions to a green economy (UNEP, 2011). The UN General Assembly has also selected the 'green economy in the context of sustainable development and poverty alleviation' as one of the main themes of the UN Conference on Sustainable Development (UNCSD) to be held in Rio de Janeiro (Brazil) in 2012.

A 'green economy' should always be considered within the wider context of sustainability and poverty eradication

Current discussions have led to a common understanding of a green economy as a "concept that brings together a suite of policies to promote investment in environmentally-significant sectors, while contributing to the pursuit of sustainable development and poverty eradication. These are derived from a range of economic approaches, concepts, ideas and principles, many of which have been articulated over the past 20 years" (UNEP, 2010). However, when the first Preparatory Committee of the UNCSD met in May 2010, it appeared that there was still no complete consensus on what a green economy entails, nor what its relationship is with the broader concept of sustainable development (UNCSD, 2010).

A green economy is historically understood as an economic system that endorses the responsibility of environmental protection. Today, the concept of a green economy has evolved to also consider social improvements. By using clean technology and clean energy, a green economy is expected to provide safer and healthier environments, create alternative green jobs[1] and preserve the development of societies (UNEP, 2008). The concept is often also associated with ideas, such as 'low-carbon growth' or 'green growth'. In the context of a green economy, the term 'growth' does not simply mean economic output growth, but indicates 'sustainable economic progress'. In fact, a green economy aims to overcome the reductionist approach that has considered Gross Domestic Product (GDP) as a simple measure of overall market economic activity as a signal of progress and societal well-being. This GDP-focussed approach proved to be misleading, as the current climate and economic crisis clearly demonstrates that growth is unsustainable with over-exploitation; in fact, destroying natural capital hampers present and future livelihoods.

Therefore, 'low-carbon growth' and 'green growth' are different ways to express the paradigm shift that no longer positions 'green' against 'development', but rather seeks ways to enforce sustainability. Sustainable development is the highest priority in global and national agendas and a green economy can be considered as a multi-faceted pathway to this goal. Each country has its own specific pathway and will design its own policies, institutional structures and implementation measures, depending on national resource endowments, challenges, needs and priorities (UNEP, 2009).

There is general agreement that the definition of a green economy should always be considered within the wider context of sustainability and poverty eradication. The implementation of a green economy must be consistent with the 27 sustainability principles identified in 1992 Earth Summit (UN, 1992). According to these principles, each country has the right to development (principle 3) and the responsibility of protecting the environment as an integral part of the development process (principle 4). Moreover, in the global international scenario, a key principle to achieve equity and justice is that countries will have 'common but differentiated responsibilities'.[2,3] This recognises the historical differences in the contributions of developed and developing countries to global environmental problems, as well as the differences in their respective economic and technical capacities to tackle these problems.

1 Green jobs are defined as work in the agricultural, manufacturing, research and development, administrative and service sectors that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials and water consumption through high efficiency strategies; de-carbonise the economy; and minimise or altogether avoid generation of all forms of waste and pollution (UNEP, 2008).

2 The Rio Declaration states: "In view of the different contributions to global environmental degradation, states have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command."

3 The UN Framework Convention on Climate Change (UNFCCC) states that parties should act to protect the climate system 'on the basis of equality and in accordance with their common but differentiated responsibilities and respective capabilities'.

MAIN ELEMENTS OF A GREEN ECONOMY

A green economy embraces a vision that tries to steer economic development in the direction of sustainability. According to the current understanding of the green economy concept, there are five main elements which support the transition to a more sustainable pattern of production and consumption (Table 13).

Being referred to as also a 'low-carbon[4] economy', a green economy is strongly commited to the use of renewable energy resources, such as wind, hydropower, biofuel, photovoltaic, solar, thermal and solid waste; seeks management approaches and new technologies that increase energy efficiency in all economic sectors; aims to reduce waste and improve waste-energy conversion; takes action to preserve natural capital or to make sustainable use of it; and boosts employment through the creation of green jobs.

These five elements of change can be implemented in all economic sectors: the primary sector, which transform natural resources into primary products and includes agriculture, forestry, fishing and all mining and quarrying industries; the secondary sector, which takes the output of the primary sector and manufactures finished goods; and the tertiary sector, which provides information and a variety of services. For all sectors, the aim is to establish — to the maximum extent possible —

Table 13
Brief description of the main elements of a green economy

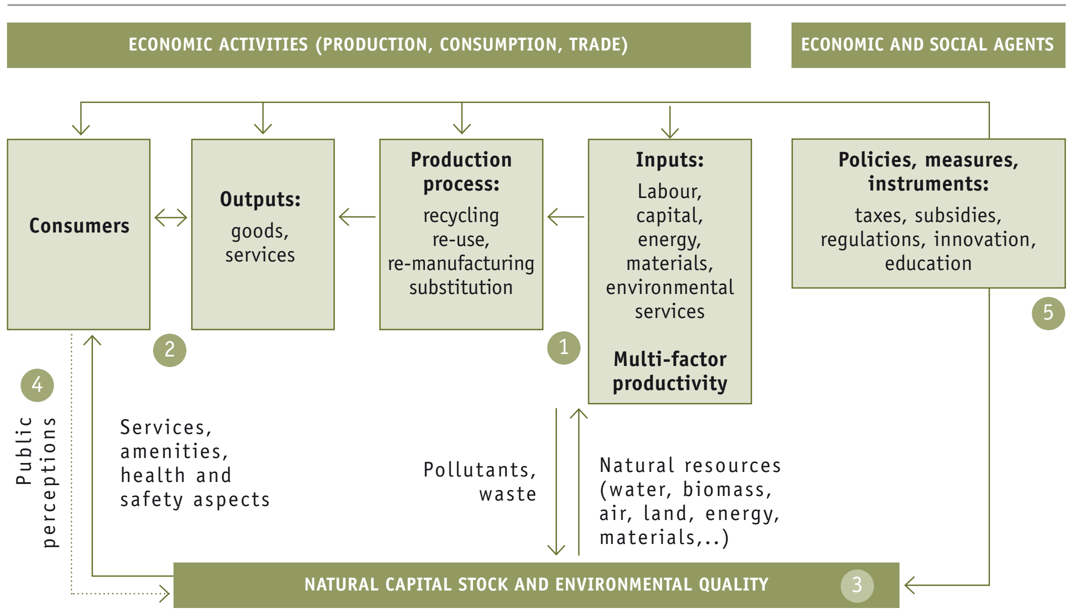
Generation and use of renewable energy	Refers to any source of usable and renewable energy intended to replace fossil fuel sources without the undesired consequences of greenhouse gas emissions and other pollutants derived from fossil fuel combustion
Energy efficiency	Seeks to adopt the means and a more efficient technology that uses less energy to provide the same level of energy service
Waste minimisation and management	Considers different approaches from prevention, minimisation, reduction, reuse, recycling, waste conversion and disposal in order to ensure that the use of materials and waste generation remains within the regenerative and absorptive capacities of the planet
Preservation and sustainable use of existing natural resources	Recognises the importance and economic value of natural resources, such as freshwater, forests, soils, coral reefs and ecosystem services provided by functional and healthy ecosystems
Green job creation	Promotes decent jobs that offer adequate wages, safe working conditions, job security, reasonable career prospects and workers' rights

4 The term 'carbon' is used for all greenhouse gases, as carbon emission calculations convert methane and nitrous oxide into carbon-equivalent units.

closed or semi-closed nutrient and energy cycles and, at least, minimise waste and boost recycling. In a green economy framework, all economic activities are characterised by the use and respect of natural capital stocks and environmental quality. Environmental efficiency is regulated and checked with feedback loops at different levels: by policies and the responses of economic actors, by indicators of stocks of natural capital and environmental quality, by production and consumption patterns and by public perception of environmental quality and life satisfaction (Figure 35).

This transition and conversion in the modality of production is also expected to create an employment shift. Alternative green jobs can be created in all economic sectors: some employment will be substituted, certain jobs may be eliminated without direct replacement, many existing jobs will simply be redefined and profiles will be greened. However, concerns still persist about possible job losses during a green economy transition and the need to evaluate unemployment rates and investments in social protection, job re-training and capacity building (UNEP, 2008).

Figure 35
Framework for a system of indicators on green growth



L E G E N D

1. Indicators of environmental efficiency of production and changes in production patterns
2. Indicators of environmental efficiency of consumpion and changes in consumpion patterns
3. Indicators of stocks of natural capital and environmental quality
4. Indicators of objective and subjective environmental quality of life
5. Indicators of responses by economic actors

Adapted from OECD, 2010

FRAMEWORK FOR A GREEN GROWTH STRATEGY DRIVEN BY THE PUBLIC SECTOR

The transition towards a green economy will require political will and economic investments in order to restructure the present model of development. The report by UNEP (2011) has pinpointed different enabling conditions and supporting actions for a transition towards a green economy. Considering the results of UNEP's analysis, a framework for a public sector-driven green growth strategy is hereby proposed (Figure 36).

For green economy activities to be attractive, viable, profitable and supported by society, certain conditions may need to be changed, shifted or created. These conditions, commonly referred as 'enabling conditions', have roots in institutional and legal frameworks, education and research and market equilibria. The depth and ramifications with which conditions are interlocked with the development of a green economy varies amongst countries, according to specific historical, political, geographical, economic and cultural contexts.

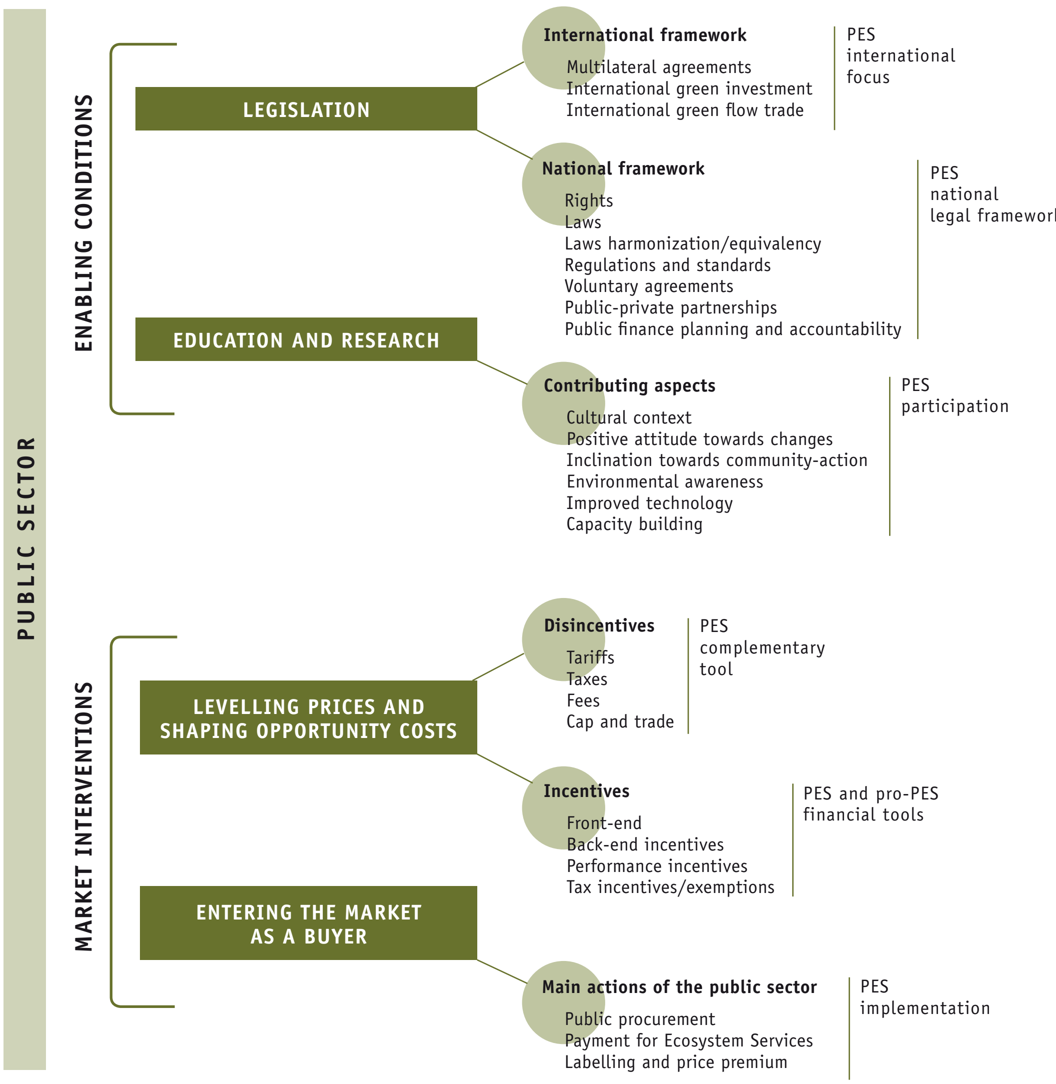
As a first level of intervention, the public sector is expected to set suitable enabling conditions both in terms of legislation, as well as in education and research. Once the legal framework and social consensus support the development of green economy activities, the public sector can start playing a major role in market interventions. In particular, the public sector is able to level prices and shape the opportunity costs of green economy initiatives by (re)designing incentives and removing/reforming harmful subsidies. In most cases, in order to make positive incentives rewarding, complementary disincentives may need to be enforced. Although the levelling the field of prices, is still part of setting enabling conditions in the economic sector, this intervention has a strong operational aspect. Thus, it can be considered a primary type of market intervention led by the public sector for green growth.

The public sector should set enabling conditions for a green economy by intervention in legislation, education and research

As a second level of intervention, the public sector is also expected to make direct investments in a green economy and enter the market as a direct buyer. In this way, the public sector can open and support new market avenues, provided that there is convergence with other market instruments in place. For example, attention must be given to existing subsidies and tax breaks that would hinder the full-scale development of a vibrant green economy. Also, public procurement is often weighted against lowest-price competitive tendering and is subject to significant pressure in times of public expenditure cutbacks.

Therefore, procurement based on non-price factors, such as environmentally-produced goods, needs to be justified in terms of its overall public benefits. In brief, by levelling prices

Figure 36
Framework for a public sector-led green growth strategy and correspondence with favourable setting for PES implementation



and setting opportunity costs for different green economy activities, the public sector can create enabling conditions for investments and business, driven by a multitude of different stakeholder groups, including international business companies, public-private partnerships, private sector, NGOs, etc.

A GREEN GROWTH STRATEGY AND PES

Looking at the above-mentioned green growth strategy, it can be asked: how does the implementation of PES fit into this framework? What could be the likely contribution of PES to a green economy? Are enabling conditions for a green economy conducive to PES requirements?

A concrete way to move towards sustainable development is to guarantee the good functioning and delivery to society of all types of ecosystem services, including: supporting services (e.g. biodiversity, photosynthesis, nutrient cycling, soil formation); provisioning services (e.g. food, water, wood, fibre, fuel); regulating services (e.g. climate stabilisation, flood prevention, drought control, water purification, disease regulation, predation, pollination); and cultural services (e.g. recreation, aesthetic experience, cognitive development, relaxation, spiritual reflection) (MEA, 2005). Clearly, PES is a market tool through which the public sector can directly and actively enter a green market and become a 'buyer' of ecosystem services. A deep insight reveals that the PES mechanism is strictly inter-linked to the enabling conditions and supportive actions that enable a green economy as a whole.

The public sector should become a buyer in Green Public Procurement, PES schemes and labelling and price premium initiatives

In the following sections, each component of the framework for a green growth strategy led by the public sector is analysed (Figure 36), with concrete examples of how the different types of enabling conditions and interventions are linked to the successful implementation of PES schemes.

LEGAL ENABLING CONDITIONS FOR PES

International frameworks

Multilateral agreements and international green trade

At the international level, the key multilateral agreement that had major repercussions on the establishment of virtual markets for the trade of natural resources has been the introduction of the Reduction of Emissions from Deforestation and Forest Degradation (REDD) for climate change mitigation. Deforestation and degradation account for around 20 percent of global anthropogenic greenhouse gas emissions, widely understood to drive climate change. The rationale of REDD is simple: countries that are willing and able to reduce emissions from deforestation should be financially compensated for doing so.

The PES mechanism is strictly inter-linked to the enabling conditions and supportive actions that enable a green economy

The process has been lengthy and the final situation is still viable for the effective conservation of forests. In the 1997 global climate agreement, the Kyoto Protocol, policies related to deforestation and degradation were excluded. In 2005, at the UNFCCC COP-11, the Coalition of Rainforest Nations initiated a request to consider the reduction of emissions from deforestation in developing countries. In 2007, COP-13 agreed that a comprehensive approach to mitigate climate change should include "policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries (i.e. commonly addressed by REDD programmes) and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (i.e. commonly addressed by REDD+ programmes)" (Parker *et al.*, 2009). In 2009, COP-15 introduced an agreement (not legally-binding though) for including agriculture and wetlands in the Kyoto Protocol. It was also proposed that REDD be considered as a multi-level nested PES scheme, ranging from the international to the sub-national level (see also Chapter 7 "Enabling conditions and complementary legislative tools for PES").

However, one of main key issues for REDD to become an effective tool to help reducing carbon emissions and contributing to the preservation of natural capital is the definition of 'forest'. According to the Clean Development Mechanism (CDM) of the Kyoto Protocol, a 'forest' is an area of more than 0.5–1.0 ha with a minimum 'tree' crown cover of 10–30 percent, with 'tree' defined as a plant growing to a height of 2–5 metres (UNFCCC, 2002). Participating countries can choose from the specified ranges for a 'forest' definition by setting different values for the minimum tree crown cover, the minimum area and the minimum tree height. While any definition suitable for global application will necessarily be composed of a few easily measured parameters, the range of the proposed parameters jeopardises the conservation of many forests and allows continued unsustainable exploitation of forest resources. In fact, the present ranges of crown cover, tree height and tree patches do not allow for discrimination between natural forests and plantations, while the thresholds for crown cover are so low that they do not capture the carbon consequences of logging of commercially valuable tree species (Sasaki and Putz, 2009).

International green public investment

The Marrakech Process on Sustainable Consumption and Production is an initiative led by UNEP and the United Nations Department of Economic and Social Affairs (UNDESA).[5] It has seven different task forces entrusted to internationally promote sustainable patterns of production and consumptions. Amongst them, there is a task force to promote Sustainable Public Procurement (SPP) by scoping existing supply-side capacities in sustainable goods and services, with a view to develop country-based SPP. Clearly, such an initiative at the international level is expected to have a major impact in the role of the public sector of participating countries as buyers in the green market.

Sustainable Public Procurement could enable countries to green the pattern of production and consumption

5 http://esa.un.org/marrakechprocess/taskforces.shtml

National legal frameworks
Rights

PES contractual agreements are largely based on land tenure. Land tenure is the relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land (FAO, 2002). Land tenure includes different types of rights: access and use rights, control rights and transfer rights (Table 14), thereby determining who can use what resources, for how long and under which conditions (FAO, 2002). Within the categories of use, control and transfer rights there are many different rights, such as the right to exclude unauthorised people from using the owned land, a right to control and decide how the land will be used, a right to derive income from the land, a right to protection from legal expropriation from the owned land, a right to transmit the rights to the land to one's successors, etc. (FAO, 2002). These different rights can be exist as bundled rights or can exist as separate rights involving different actors.

Land tenure includes various types of rights, which determine who can use what resources, for how long and under which conditions

The definition of clear property rights is a pre-requisite for PES implementation. In areas where there are no statutory rights or formally recognised rights (i.e. explicitly acknowledged

Table 14
Property, ownership rights and laws

Who has property rights	Type of ownership rights	Statutory or customary laws
Public (held by the state)	Access and use rights (rights to access the land to use its natural resources)	Statutory law (the written and codified law of a country including both state and municipal legislation)
Private (held by a natural or legal person)	Control rights (rights to make decisions on how the land and its natural resources should be used)	Customary law (traditional rules, norms and customs)
Communal (held by each member of a community)	Transfer rights (rights to sell, convey, mortgage, reallocate access, use and control rights and transmit the land to heirs)	
Openly accessible (not assigned to anyone)	Not specified	Not specified

Adapted from Greiber, 2009

by the state and which may be protected using legal means; FAO, 2002), the preliminary phase of a PES scheme can include the legal allocation of land property rights. On the other hand, PES can also be applied in situations where there are customary and/or traditional rights (i.e. informal, as they lack official legal recognition), but the *de facto* are considered as formal and secure in their own social context (Greiber, 2009).

In the implementation of REDD, other specific rights linked to the forest use and management should also be considered. These rights include usufruct rights, commercial rights on some timber species and carbon property rights. In particular, under the REDD policy, once forests become a product that can be traded, the issue of forest and carbon ownership becomes critical.

The framework for REDD in Ghana provides an example on how these different legal layers interact with each other. About 80 percent of land in Ghana is under the ownership and control of customary authorities in the form of stools/skins (i.e. families, clans and heads of communities), with the remaining 20 percent owned by the state. As for trees, those that naturally grow on the land are owned by customary authorities, while commercial rights to timber species are owned by the state despite of where they grow. Thus, farmers usually do not have tree tenure on timber species naturally occurring on their land. The Katoomba Group questioned whether they had the rights to the REDD benefits of carbon storage if they could not own the trees (The Katoomba Group, 2009). In Ghana, farmers have the user rights to cut trees and natural vegetation for agricultural purposes though, so clearing land is also a way in which land property is informally claimed. Thus, in Ghana, for REDD to work, a PES scheme should secure and clarify property rights and, at the same time, compensate the farmers for the opportunity cost of clearing their land.

Communal management and ownership of forests is very common in developing countries; of the 233 countries and areas covered by FRA (2010) about 20 percent of the private-owned forests are formally recognised as community reserves or community-owned. If the state decides to retain carbon property rights, the government will control all the potential benefits. Communities (or other stakeholders) will not have additional motivation to protect forests unless their benefits will be secured and guaranteed by a clear legal mandate. Legal recognition of land titles can be a pro-poor strategy, as farmers' incomes can significantly increase, as in the case of Sumberjaya, Lampung province (Indonesia), as they no longer have to pay bribes to keep from being evicted from their lands (see Case Study 13 "PES and multi-strata coffee gardens in Sumberjaya, Indonesia")

When property rights on land tenure are clarified and formalised, a well-defined legal apparatus is also needed to enforce property rights and contest land claims when they arise (Greiber, 2009).

Laws

The importance of a legal framework for successful PES development varies with the type of PES scheme. A private PES scheme, in which both the buyer and seller are private entities, uses basic legal requirements for agreements contracts (see also Chapter 7 "Enabling conditions and complementary legislative tools for PES").

In a public PES scheme, the public sector is involved as at least one of the contracting parties. In this case, the legal framework should provide the authority to a public entity to enter into legal agreements. The statutory legislation should also determine the rights and responsibilities of an independent authority that should monitor and supervise the process to ensure transparency (Greiber, 2009). A PES-specific legislation can be created with some clear advantages. However, according to the extent to which the legislation is developed and harmonised, some disadvantages might also occur (Table 15). If legal uncertainty arises by incomplete PES-specific legislation, this can be a strong disincentive for the buyer and seller to enter into an agreement. A general criterion of PES-specific legislation is that, while aimed at facilitating PES development and implementation, prescription in the legislation should be kept at minimum to avoid over-regulation and bureaucracy.

There are no golden rules for an ideal institutional setup but they should be adapted to the local circumstances

There are no golden rules for an ideal institutional setup. On the contrary, institutions, which include both the national legal framework and the government system structure, should be adapted to local circumstances.

To date, PES-specific laws exist in Argentina and Costa Rica. In Argentina, Law No. 26.33185 defines ecosystem services as the tangible and intangible benefits generated by ecosystems that are necessary for the survival of natural and biological systems, as well as for the well-being of Argentineans (Lugo, 2008). In Costa Rica, Forest Law No. 7575, enacted in 1996, explicitly acknowledges four categories of ecosystem services that are delivered by forest ecosystems: mitigation of greenhouse gas emissions; hydrological services (which includes water for human consumption, irrigation and energy production); biodiversity conservation; and scenic beauty for recreation and ecotourism. This law provides the regulatory basis to compensate landowners for the services provided by their lands and, for this purpose, established the National Fund for Forest Financing (Fondo Nacional de Financiamento Forestal, FONAFIFO) (Pagiola, 2006).

As PES uses basic legal requirements for agreements contracts, there is no need for constitutional recognition of PES. However, existing laws should not indirectly disrupt the development or the success of PES schemes (Greiber, 2009).

Table 15

Advantages or disadvantages of a PES-specific law

Advantages	Disadvantages
Attention drawn to PES in general	
Awareness raised for PES as a legitimate policy instrument	
Comprehensive codification developed	Environmental legislation further fragmented
Scope of PES instruments clarified	Complexity of legal framework increased
Legal certainty created	Conflicting legal framework created
Implementation supported	Implementation hampered

Source: Greiber, 2009

Law harmonisation/equivalency

If PES is regulated in a PES-specific law, attention must be paid to its integration in the existing legal and institutional frameworks, in particular those laws that regulate ecosystem management. Two opposite examples are found in Costa Rica and Indonesia. Legislation in Costa Rica prohibits forestry clearing and this reinforces the potential success of PES forest conservation programmes.

By restricting the range of income-generating options from forested land, this legislation makes PES more economically attractive. On the contrary, legislation in Indonesia provides government subsidies to farmers who clear land for conversion to rubber monoculture. This stands against the success of a PES scheme that provides incentives to farmers to maintain mixed jungle-rubber agroforestry systems (see Case Study 4 “PES and rubber agroforestry in Bungo district, Indonesia”).

Regulation and standards

Regulation and standards have crucial roles to play, as PES programmes often operate in contexts in which various command-and-control regulations pre-exist. In some situations, the occurrence of PES can be complementary to existing regulations; PES can be thought of as providing a carrot that makes the stick of regulations more palatable. In other cases, conflicting regulations can provide indirect benefits for non-compliance with PES agreements and/or can indirectly determine very high opportunity costs for PES schemes.

A 'perfect PES case', as described in Perrot-Maître (2006), in which existing regulations were proactive in the establishment of PES, is the Vittel (Nestlé Waters) privately-financed programme implemented in a 5 100 ha catchment in the Vosges Mountains (northeastern France) for the maintenance of high water quality. Since 1993, Vittel has been paying 26 farmers in the watershed to adopt best low-impact practices in dairy farming; long-term contracts (18-30 years) and payments are adjusted according to opportunity costs on a farm-by-farm basis. Land-use and water quality are monitored over time and this has provided evidence of improvement in relevant ecosystem services, compared to an otherwise declining baseline. This programme took almost ten years to be fully implemented. The interest of this private company in securing a successful PES programmes arises from the fact that, in France, regulations on natural mineral water are very strict. Standards for a 'natural mineral water' label require the elimination of naturally-occurring unstable elements (such as iron and manganese), no pesticides and no more than 4.5 mg of nitrates per litre of water. Even more important, the legislation does not allow the treatment of natural mineral water. As the legislation makes payments to farmers the cheapest solution, it has induced a market strategy by Nestlé Waters; a similar approach is being followed by other mineral water brands, such as Perrier and Contrex (Perrot-Maître, 2006).

Regulations and standards have crucial roles to play, as PES programmes often operate in contexts in which various laws pre-exist

Standards can be also voluntary, as practiced by the agri-food industry, through environmental labels (e.g. Rainforest Alliance, Marine Stewardship, Forest Stewardship, biodynamic agriculture) that are in demand by environmentally-aware consumers willing to pay price premiums for quality and/or specialty products. For example, organic markets (currently representing two percent of global food retail) have grown for decades on the basis of voluntary standards; labels relating to Geographical Indications are also very common. In such markets, the fact that consumer demand is the main driver of growth stresses the importance of building awareness on the benefits of internalising environmental values in commodity prices.

Voluntary agreements

Amongst possible tools to mainstream a green economy, PES and other voluntary agreements are particularly promising when the regulatory capacity is weak or where there is no regulatory authority at all. In the case of PES, its voluntary nature also poses some constraints for the implementation of eco-efficient solutions in ecosystem management: the possibility for landowners to withdraw from a contract at any time; the likelihood of landowners not joining the programme to act as free-riders or to become an obstacle to the success of the programme;

or the eventual lack of spatial connectivity amongst land plots subject to the PES programmes (see Viewpoint 3 "PES design: Inducing cooperation for landscape-scale ecosystem services management").

Public-private partnerships

Attracting green investments is one of the major accelerators for green growth. In some cases, governments leverage private investments in specific areas by co-investing through public-private partnerships, which enables market conditions attractive to private investments (UNEP, 2011). As such, PES schemes constitute a very flexible tool that can attract private investments, as well as public-private partnerships. The key issue in deciding the possibility or the degree to which ecosystem services could be privatised though relates to the extent to which they are public goods.

Planning and accountability of public finance

In some countries, PES schemes could be hampered by the short-term planning and accountability systems of public finance. For example, in the Cidanau watershed of Indonesia, major difficulties were encountered in 2002 by the PES programme, as the government budget plan was applicable only for one year (Budhi *et al.*, 2008). Usually, the implementation of PES requires a PES contract of at least 5-10 years, implying a multi-year public budgeting commitment. This remains a key hurdle in public financing though, considering the relatively short election cycles.

EDUCATION AND RESEARCH ENABLING CONDITIONS FOR PES

Environmental awareness

Environmental awareness influences the daily choices and investments of different stakeholders, whose behaviour in turn affects the opportunity costs and market avenues for green public and private investments. Motivational drivers also influence the willingness to participate in PES programmes (see Chapter 5 "Social and cultural drivers behind the success of PES"). For example, a survey was carried out in Florida to examine the willingness of private forest owners to participate in a conservation programme that required adopting silvicultural management practices beyond the existing regulations. The survey of 1 500 randomly sampled forest owners revealed that forestry and conservation organization membership, which can be considered as a proxy for environmental awareness, increased the probability of forest owners to participate in the programme (Matta *et al.*, 2009).

Cultural context

The cultural context can encourage the development of policies and institutions to achieve social equity and respect for natural resources. For example, the Andean Water Vision,[6] built on indigenous culture, requires water to be considered as a public property in the constitution and under the control of society as a whole. In this cultural context, PES can be considered socially inappropriate and there may be strong resistance towards PES for water provision and water quality, particularly if this is accomplished through an agreement with the private sector.

Positive attitude towards changes and inclination towards community action

Communities are often heterogeneous and the degree of inclination towards community action varies according to its members. In Ecuador, a biodiversity PES programme led by the Deutsche Gesellschaft für Internationale Zusammenarbei (GTZ) and Conservation International was agreed to in 2004 with three communities, comprising approximately 300 households, living in the Gran Reserva Chachi, an area of high biodiversity value facing strong pressure from timber companies and the expansion of oil palm plantations. The success of this PES programme varied among the three communities, depending on the inclination of individuals to abandon the income earned from logging and traditional subsistence wildlife hunting (Wendland, 2008).

Improved practices, technology and capacity building

A green economy relies highly on improved management practices, technology and capacity building to achieve renewable energy generation and energy efficiency. Improved green technology and the ecosystem approach to management can indeed be the focus of some PES schemes. In fact, while PES forest schemes for biodiversity conservation or carbon sequestration call for retaining existing land uses, other PES schemes foster the adoption of silvo-pastoral (Pagiola *et al.*, 2007; Rios and Pagiola, 2009) and agro-ecological practices (Turpie *et al.*, 2008).

6 http://www.condesan.org/memoria/agua/AndeanVisionWater.pdf

Improved technology, which is mainstreamed in some PES schemes, is promoted to avoid soil erosion, contamination of water supplies, air pollution and landscape degradation. Farmers enrolling in these PES schemes usually learn how to terrace their lands, to plant trees and shrubs in areas of degraded pastures, to use local and fast-growing trees and shrubs for fencing and wind-screens and/or to clear alien invasive trees. It has been suggested that a PES scheme could also be designed to allow farmers to suggest, invent and adopt innovative approaches (Jack *et al.*, 2008). Rewarding the target without binding the farmer to certain practices could encourage farmers to experiment and also implement innovative approaches to comply with the PES requirements. It is assumed that when innovations to achieve renewable energy generation and energy efficiency become available or adopted at a large scale, PES schemes could be a possible way to encourage and disseminate the use of different practices and technologies.

PES schemes could be a possible way to encourage and disseminate the use of different practices and technologies

LEVELLING PRICES AND SHAPING OPPORTUNITIES COSTS FOR PES

The opportunity cost of different investments and activities is highly dependent on the resulting interaction in the market between incentives and disincentives. Redesigning existing incentives per se can be extremely efficient in redirecting the economy in a greener direction. For example, when Ghana reformed its fuel subsidies, primary and junior-secondary school fees were eliminated; the government also made extra funds available for primary healthcare programmes concentrated in the poorest areas (IMF, 2008). Furthermore, it is generally more efficient to raise the cost of unsustainable activities through regulations or instruments that help price them at their true cost, thereby making sustainable alternatives relatively more attractive.

Disincentives

Tariffs

Tariffs are usually applied to the trade of some products or can be feed-in tariffs, where the cost of the production of a product or activity is included into its price. For example, in the town of Heredia (Costa Rica), the introduction of a near-zero nominal fee applied to all water users was able to finance PES schemes aimed at improving the quality of water provided to Heredia town from the forested upper watersheds (see Case Study 12 “PES for improved ecosystem water services in Heredia town, Costa Rica”).

Taxes

Tax applications and exemptions could be another tool through which the public sector can influence consumers and citizens choices. In particular, the vision of green taxes is based on the principles of 'the polluter pays' and 'tax what you take, not what you make'. The revenue that is raised from such taxes can be used in a variety of ways: to help undo the damage done by unsustainable production and consumption; to promote green economy activities; or to contribute to other priority areas where government spending for society is necessary.[7] For example, in Costa Rica, the bulk of the PES programme financing has been obtained by allocating 3.5 percent of the revenues from a fossil fuel sales tax (about USD 10 million a year) to the National Fund for Forests Financing (FONAFIFO) (see also Chapter 4 "Cost-effective targeting of PES").

Fees

Fees can be applied by users of certain goods with rates charged differently to certain user groups (e.g. commercial, non-commercial) and/or can be associated to a permit or a concession. The revenue raised by such fees can be reinvested into green activities generating positive feedbacks. For example, in Germany, the Bundesländer (Federal State) applies groundwater extraction fees to water utility companies, part of which is used to pay farmers for the provision of ecosystem services encouraging them to reduce use of nitrogen-based fertilisers and pesticides. The resulting synergy between water utilities fees and environmentally-friendly agronomic practices ensures the protection of groundwater and, thus, provides improved water quality and use for both the farmers and the water utilities companies. The success and popularity of very simple PES programmes, such as the one just described, can be measured by its scale of implementation. In 2002, 33 000 farmers and over 850 000 hectares (i.e. five percent of agricultural land in Germany) were involved in the programme (TEEB, 2009).

Cap-and-trade

Cap-and-trade is another market tool that can be used for national and international markets. By establishing a cap (i.e. an aggregate maximum amount), this regulation allocates permits which divide the allowable overall total among users of natural resources and allows trading of permits between those who do not need permits and those who need more than their allocation. The linkage between cap-and-trade mechanisms and PES is clearly shown by the carbon finance cap-and-trade system and REDD (see also Chapter 7 "Enabling conditions and complementary legislative tools for PES").

Incentives

Front-end incentives

Front-end incentives are often a major propeller of change as they provide financial resources for any change to be implemented. In PES, front-end incentives might be very important if the programme aims to involve the poorest stakeholders. Front-end incentives might cover transaction costs, which often in very tight household budgets constitute one of the major constraints to programme participation (see also Chapter 6 "Landscape labelling approaches to PES: Bundling services, products and stewards").

Back-end incentives

The current rewards of PES can be considered as back-end incentives that are given once the negotiation phase has been concluded and the contract has been agreed and signed by the two counterparts.

Performance incentives

Performance incentives are a form of direct-payment made upon verification of a tangible direct effect that can signal the success of the PES scheme. PES based on performance aims to overcome the drawbacks usually existing between indirect-payment conservation interventions (e.g. eco-friendly commercial activities) and the preservation of ecosystem services.

For example, in order to foster forest conservation in Madagascar in 1991-1995, an indirect-payment conservation initiative provided beehives to farmers. Given that honey production requires nectar and pollen inputs from rainforest plants, it was thought that beekeeping would provide the incentive needed for forest conservation. However, Ferraro and Simpson (2002) discussed that the implementation of this initiative might have led to the opposite effect. In fact, honeybees feed on a small set of forest plants that have a heterogeneous distribution; thus, the interest of the farmer could only be directed to conserve some patches of forest and not the whole forest extent.

Moreover, the farmer could be led to manipulate forest species composition and eliminate the 25 percent of forest species on which honeybees do not forage. Farmers could also detect that, in some cases, a consistent percentage of the pollen came from secondary forests and exotic plantations and this might reduce their interest in conserving their forest patches. Last by not least, farmers could not prevent honeybees from neighbouring fields from foraging on their forest patches, thus they decided that the best course of action was to convert their forest patches into agriculture fields and allow honeybees to forage on neighbouring forest parcels and/or plantations instead.

To overcome these possible drawbacks, PES schemes try to establish a direct link between the payment/rewards and the provision of ecosystem services. The agreement is meant to be conditional on the continuous delivery of this service. While back-end incentives are usually issued as a consequence of the end of a negotiation/implementation process, performance incentives are meant to be issued on the basis of a monitoring process.

Some PES schemes have a payment scheme that includes an initial baseline payment, followed by additional payments based on degree of performance/success recorded. For example, on Mafia Island (Tanzania), a PES project was established for the protection of a population of green turtles (*Chelonia mydas*) almost driven to extinction by poaching activities. A fixed amount was delivered for finding and reporting a nest, while additional variable payments were delivered as a function of the nest's hatching success (Ferraro, 2007). This payment scheme was aimed at ensuring the effective increase of turtle birth rate and at discouraging possible leakage (i.e. the contractor first receiving payment to detect the nest and subsequently being able to exploit the nest).

Some PES schemes include an initial baseline payment, with additional payments based on the degree of performance/success recorded

An even better articulated example of performance incentives is given by the Silvopastoral Ecosystem Management project to increase carbon sequestration and biodiversity conservation (Rios and Pagiola, 2009). Farmers received an initial baseline payment as recognition of the ecosystem services that were preserved by them until that moment, with no obligation to participate further in the programme. Once enrolled in the PES programme though, farmers received compensation proportional to the amount of land-use change that was detected on their lands.

Tax incentives/exemptions

In a green economy, tax exemption can be considered as a way to provide preferential support to the development of new technologies, practices and markets. As taxes are considered one of the main means of achieving long-term funding for PES, tax exemption linked to a PES should be always evaluated within a larger framework of equity and social justice.

Entering the market as a buyer

There are mainly three ways in which the public sector can enter the market as a direct buyer: through public procurement (by sourcing environmentally-friendly products and, thus, encouraging the production of environmental goods and services); through labelling (by regulating environmental labels, thus ensuring fair play in terms of price premiums whereby consumers pay for environmental stewardship); and through PES (UNEP, 2011). Ecosystem services can be a critical tool for the public sector to administer, preserve and restore public goods, while opening green development pathways.

STRENGTHENING A GREEN ECONOMY WITH PES

The real contribution of PES to a green economy depends primarily on the capacity to design sustainable PES programmes

Consideration of the various elements of a green growth strategy reveals that most enabling conditions are also crucial for the implementation of PES schemes. This implies that green growth policies can highly influence the success of PES schemes. Similarly, PES schemes, depending on the scale of their implementation, can promote social acceptance and stakeholder participation in a green economy. PES will certainly contribute to the understanding of the importance of the ecosystem services, bringing ecological awareness and active social participation in governance. Moreover, PES schemes could be implemented with respect to the equity principle; the green jobs concept could, in fact, be designed to mainstream preservation of ecosystem services and poverty alleviation. **PES** is not a silver bullet though and clearly **will not work if**:

- **Governance is weak and unable to set favourable enabling conditions**;
- **Transaction costs are very high**, for instance, due to land fragmentation;
- **Competing destructive resource usages are highly lucrative**;
- **Resources tenure or use rights are insufficiently defined or enforced**.

However, under such circumstances, it is unlikely that governments will have effective alternative tools to properly manage ecosystem services, as command-and-control regulations will also be likely to fail. Thus, a negative evaluation obtained during a feasibility study for a PES project can be important to pinpoint priority areas of intervention in the market and relevant institutions. The real contribution and efficacy of PES to the development of a green economy depends primarily on the capacity to design sustainable PES programmes.

REFERENCES

Budhi, G., Kuswanto S.A. & Iqbal, M. 2008. Concept and implementation of PES programme in the Cidanau watershed: A lesson learned for future environmental policy. *Analisis Kebijakan Pertanian*, 6: 37–55.

FAO. 2002. *Land tenure and rural development*. FAO Land Tenure Studies 3. Rome, FAO.

FAO. 2010. *Global forest resource assessment 2010. Main report*. FAO Forestry Paper 163. Rome, FAO.

Ferraro, P. 2007. *Performance payments for sea turtle nest protection in low-income nations: A case study from Tanzania* (available at http://www2.gsu.edu/~wwwcec/docs/doc%20updates/NOAA%20Paper%20TZ%20Final%20Draft%20June%202007.pdf).

Ferraro, P.J. & Simpson, R.D. 2002. The cost-effectiveness of conservation payments. *Land Economics*, 78(3): 339–353.

Greiber, T., ed. 2009. *Payments for ecosystem services. Legal and institutional frameworks*. Gland, IUCN-The World Conservation Union.

IMF. 2008. *Fuel and food price subsidies: Issues and reform options*. Washington, D.C., International Monetary Fund.

Jack, B.K., Kousky, C. & Sims, K.R.E. 2008. Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *Proceedings of the National Academy of Sciences*, 105: 9465–9470.

Lugo, E. 2008. Ecosystem services, the Millennium Ecosystem Assessment and the conceptual difference between benefits provided by ecosystems and benefits provided by people. *Journal of Land Use and Environmental Law*, 23(2): 243–261.

Matta, J.R., Avalapati, J.R.R. & Mercer, D.E. 2009. Incentives for biodiversity conservation beyond the best management practices: Are forestland owners interested? *Land Economics*, 85: 132–143.

MEA. 2005. *Ecosystems and human well-being: synthesis*. Washington, D.C., Island Press.

OECD. 2010. *Interim report of the green growth strategy: Implementing our commitment for a sustainable future*. Paris, Organisation of Economic Co-operation and Development (available at http://www./dx.doi.org/10.1787/9789264087736-en).

Pagiola, S. 2006. *Payments for environmental services in Costa Rica* (available at http://mpra.ub.uni-muenchen.de/2010/).

Pagiola S., Rios, A.N. & Arcenas, A. 2007. *Can the poor participate in payments for environmental services? Lessons from the Silvopastoral Project in Nicaragua*. MPRA Paper, No. 3705 (available at http://mpra.ub.uni-muenchen.de/3705/).

Parker, C., Mitchell, A., Trivedi, M., Mardas, N. & Sosis, K. 2009. *The little REDD+ book*. Oxford, Global Canopy Foundation.

Perrot-Maître, D. 2006. *The Vittel payments for ecosystem services: A "perfect" PES case?* London, International Institute for Environment and Development (IIED).

Rios, A.R. & Pagiola, S. 2009. *Poor household participation in payments for environmental services in Nicaragua and Colombia*. MPRA Paper, No. 13727 (available at http://mpra.ub.uni-muenchen.de/13727/).

Sasaki, N. & Putz, F.E. 2009. Critical need for new definitions of "forest" and "forest degradation" in global climate change agreements. *Conservation Letters*, 2: 226–232.

TEEB. 2009. *The economics of ecosystems and biodiversity for national and international policy makers – Summary: Responding to the value of nature 2009*.

The Katoomba Group. 2009. *Realising REDD: Implications of Ghana's current legal framework for trees* (available at http://147.202.71.177/~foresttr/documents/files/doc_2354.pdf).

Turpie, J.K., Marais, C. & Blignaut, J.N. 2008. The Working for Water Programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. *Ecological Economics*, 65: 788–798.

UN. 1992. *United Nations Conference on Environment and Development (UNCED)*. UN Doc. A/CONF.151/26 (Vol. I); 31 ILM 874.

UNCSD. 2010. *First preparatory committee meeting for the UN Conference on Sustainable Development 2012.Co-chairs' summary, 19 May 2010*.

UNEP. 2008. *Green jobs. Towards decent work in a sustainable, low-carbon world* (available at http://www.unep.org/labour_environment/features/greenjobs.asp).

UNEP. 2009. *Global Green New Deal. An Update for the G20 Pittsburgh Summit*.

UNEP. 2010. *First Meeting of the Issue Management Group on Green Economy 23–24 March 2010, Washington*.

UNEP. 2011. *Green economy report. Pathways to sustainable development and poverty eradication* (available at http://www.unep.org/greeneconomy).

UNFCCC. 2002. *Report of the Seventh Session of the Conference of the Parties, Marrakesh 2001* (available at http://unfccc.int/resource/docs/cop7/13a01.pdf).

Wendland, K. 2008. *Rewards for ecosystem services and collective land tenure: Lessons from Ecuador and Indonesia*, pp. 1–10. University of Wisconsin-Madison, Land Tenure Centre.

Wunder, S. 2005. *Payments for environmental services: Some nuts and bolts*. Occasional Paper, No. 42. Bogor, Centre for International Forestry Research (CIFOR).

PES DESIGN: INDUCING COOPERATION FOR LANDSCAPE-SCALE ECOSYSTEM SERVICES MANAGEMENT

Rebecca L. Goldman

Inter-American Development Bank (IDB), Washington, D.C., USA

Based on: Goldman, R., Thompson, B.H. & Daily, G.C. 2007. Institutional incentives for managing the landscape. Inducing cooperation for the production of ecosystem services. *Ecological Economics*, 64: 333-343.


© FAO/S. Elliot


© FAO/M. Uz Zaman

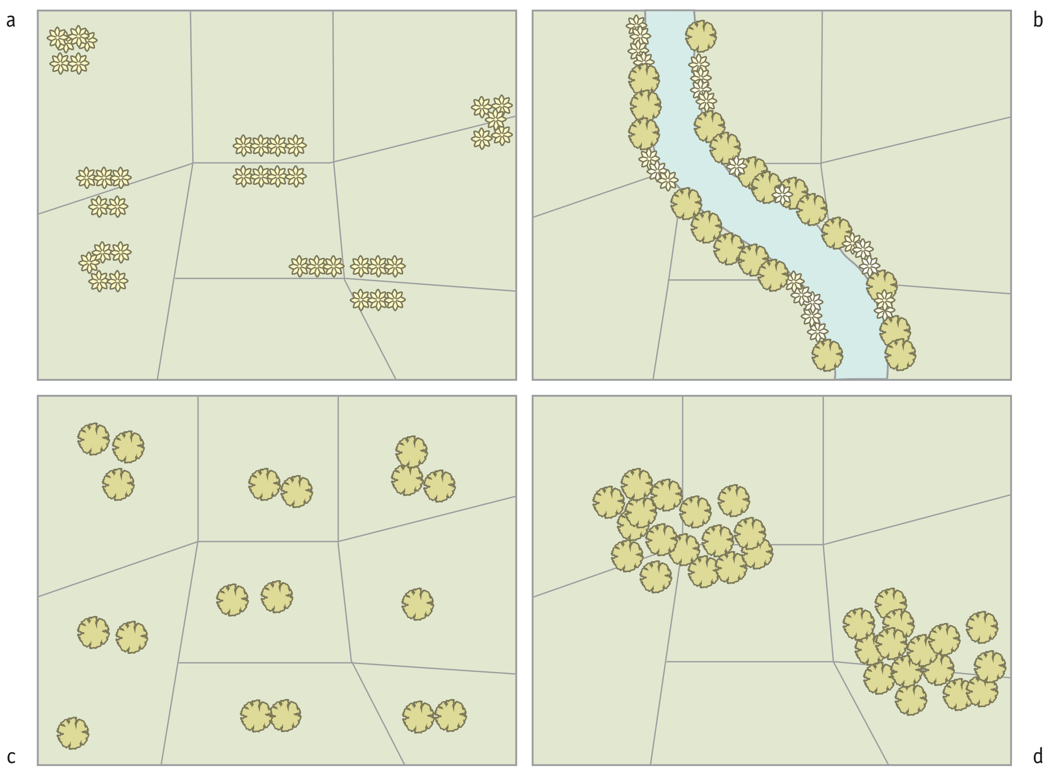
Ecosystem services, especially regulating services, such as carbon sequestration, regulation of water flow, flood protection, erosion and sedimentation control, pollination, breakdown of excess nutrients, creation of habitat connectivity critical for the survival of many large terrestrial animal species and water purification, among others, are provided at a landscape scale, thereby requiring landscape-scale management. Such management can help ensure the resilience of agricultural systems now and into the future, while also conferring other benefits to people. It also requires cross-boundary cooperation amongst landowners and managers to be successful.

Current incentives to influence land management are often focused on incentivising conservation and agronomic practices at a parcel-scale, providing only marginal value in ecosystem services production. Using three ecosystem service examples — pollination (small-scale operation), water purification (medium-scale operation) and carbon sequestration (large-scale operation) — the importance of landscape composition and configuration for sustainable agriculture are demonstrated and possible incentives to achieve these configurations are suggested.

Configuration (placement) and composition (type) of native vegetation on agricultural landscapes are critical for service provision. Native pollinators can provide resilient pollination services of great value (in Costa Rica, native pollinators were valued at USD 60 000/year for coffee; see Ricketts *et al.*, 2004) best generated through landscape mosaics of cropland mixed with patches of native habitat and floral resources that are relatively close together (100-1 000 metres), mosaics which reflect the foraging activity and range of pollinators (Ricketts *et al.*, 2004; Brosi *et al.*, 2007). Agricultural landscapes can also support water purification and flood reduction services (among other water services) through a variety of management practices.

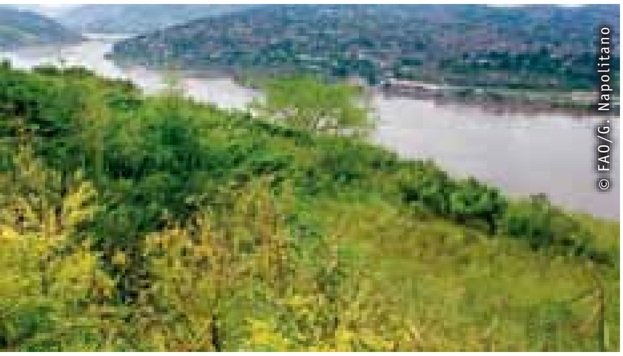
Figure 37

Importance of configuration (placement) of native vegetation on agricultural landscapes for service provision



In each quadrant, trees and flowers represent conserved area. Light green is intensive agriculture and the grey lines delineate property boundaries. In (b), the light blue curve is a river. Each quadrant also represents a possible landscape composition and configuration that could promote certain services: (a) would promote local services, such as pollination, given the floral resources; (b) is appropriate for regional services, such as water purification and flood mitigation; (c) represents a landscape in which the critical mass of a particular composition (trees), rather than configuration, is important, i.e. a certain number of landowners must participate; and (d) is an example where the critical mass matters less, but landscape configuration is important and composition remains critical. Trees must be clustered together to form a large forest patch. Either (c) or (d) would be appropriate for global services, such as carbon sequestration, while (d) would be preferable for long-term ecosystem service provision.

Adapted from original drawing by Rebecca Goldman (IDB)



© FAO/G. Napolitano

Previous page (from left to right):
↖ In many rural communities, harvesting is labour intensive and relies on cooperation.
↖ A landscape approach is essential for the preservation of many regulating services of agro-ecosystems.

Current pages (from left to right):
→ Social networks, sharing assets and capacity building are essential for good community programmes.
→ Successful PES schemes in diverse landscapes need cooperation among landholders.
→ Community cooperation for the conservation of a riparian buffer is essential for the provision and preservation of water services.

For example, by managing riparian buffers and/or wetlands, agricultural run-off can be filtered of chemicals and sediments and can be reduced in speed and quantity before entering adjacent waterways. Such buffering requires precision in landscape configuration as the buffers need to line the waterways and only continuous buffers along the length of the river and/or stream will have a significant impact. There is, however, flexibility in composition as a variety of plants and/or wetlands and management practices can help stabilise soils and slow runoff. Finally, agricultural landscapes can provide global services in the form of above-ground (and below-ground) carbon sequestration. Planting or maintaining tree cover can further provide such climate stabilisation services. In the short term, there is complete flexibility in the placement of trees. However, in the long term, wind and other stresses can lead to the recession of fragments (Cochrane and Laurance, 2002), emphasizing the benefit of consolidation of tree patches into larger areas to maintain service values. Such consolidation can yield multiple benefits, including potential wildlife corridors which require particular widths and lengths to be effective. Therefore, if landscapes are managed with future carbon sequestration services in mind, various conservation benefits can then arise. As illustrated, in terms of the production of the three scales of services on agricultural landscapes, there are mixed considerations for configuration and composition (see Figure 37) of native vegetation.

Financial incentives can promote these landscape mosaics by providing local on-farm benefits (e.g. soil stabilisation, nutrient cycling and pollination) and broader benefits (e.g. clean water, carbon sequestration and flood mitigation). For example, providing a bonus for cross-boundary conservation and thereby encouraging landowners and managers to work together can create many of the landscape configurations described previously. If a landowner was planning to grow a riparian buffer through a cost-share programme, for example, but he/she could receive a much higher percentage of the cost share or perhaps the full cost for the buffer if he/she got a neighbour to sign up as well, then this would encourage the creation of riparian buffers across the landscape, rather than just on one parcel.

Other types of incentives could induce similar cooperation. For example, if an incentive programme were to reward cooperative behaviour through a competitive application process, groups of landowners would have an incentive to creatively maximise service benefits from cooperative behaviour in order to raise the quality of their proposed management. Incentives could then be awarded to groups based on quality and maximised benefits to ecosystem service provision. Another approach could be to create rewards for groups of landowners and/or managers who organise around ecosystem service districts combining regulatory and incentive-based approaches. While there are few examples of this type of landscape vision in policies to support management of agricultural landscapes, rapidly proliferating PES programmes and ever-developing government incentive programmes provide a foundation for and examples of how these incentives can become more commonplace.

Providing incentives to neighbouring farmers to enrol in PES schemes can increase cooperation and future mutual-aid relationships.
From left to right:

→ Sharing and exchanging resources is an important way to overcome smallholder constraints.

→ Afforestation and carbon sequestration projects benefit farmers, communities and global society.

→ Beekeeping often involves cooperation among farmers to preserve a mosaic of foraging and nesting patches.

REFERENCES

Brosi, B.J., Daily, G.C. & Ehrlich, R. 2007. Bee community shifts with landscape context in a tropical countryside. *Ecological Applications*, 17: 418–430.

Cochrane, M.A. & Laurance, W.F. 2002. Fire as a large-scale edge effect in Amazonian forests. *Journal of Tropical Ecology*, 18: 311–325.

Ricketts, T.H. 2004. Tropical forest fragments enhance pollinator activity in nearby coffee crops. *Conservation Biology*, 18: 1262–1271.

Ricketts, T.H., Daily, G.C., Ehrlich, P.R. & Michener, C.D. 2004. Economic value of tropical forest to coffee production. *Proceedings of the National Academy of Sciences*, 101: 12579–12582.

PES FOR IMPROVED ECOSYSTEM WATER SERVICES IN HEREDIA TOWN, COSTA RICA

Luis Gamez
Public Utilities Company of Heredia (ESPH), Heredia, Costa Rica

A pioneering, financially self-sufficient PES scheme was promoted in Costa Rica by the Public Utilities Company of Heredia (ESPH) to protect the water supply of the city of Heredia and surroundings (population about 200 000 inhabitants).

Unplanned urban growth and the loss of adequate forest cover in five key watersheds (Río Bermudez, Río Ciruelas, Río Para, Río Segundo and Rio Tíbas) within the Heredia catchment area risked to hamper ecological functioning, such as the filtration and recharge of groundwater (Figure 38). Deforestation was mainly linked to the conversion of forests to abandoned grasslands and dairy activities in the upper watershed areas. Since the year 2000, the Public Utilities Company of Heredia (ESPH) endorsed an adjustment to the water tariff introducing a fee to make water-users contribute directly to the cost of forest protection. A socio-economic study amongst the citizens of Heredia revealed that 90 percent of the interviewed customers supported the idea and were willing to pay up to 10-12 Costa Rican colones/m^3/month. A green fee of less than 10 Costa Rican colones (equivalent to USD 0.20) per m^3 of water used has been charged since 2000 in the monthly water bill to all categories of end-users, including residential, commercial, social, industrial and public institutions. The fee represents only 1-2 percent of the monthly water bill and has a very low impact even on poor family incomes. The financial resources coming from the water fee was used to compensate private landowners for the lost opportunity cost of converting forests on their lands. The amount paid annually for forest protection is USD 120/ha for ten years, while the reward for reforestation activities is USD 1 200/ha for five years. In addition, a direct, economic incentive equal to about USD 10 000 was paid from 2000-2002 for the conservation of forests managed by the Braulio Carrillo National Park, bordering on the study area.

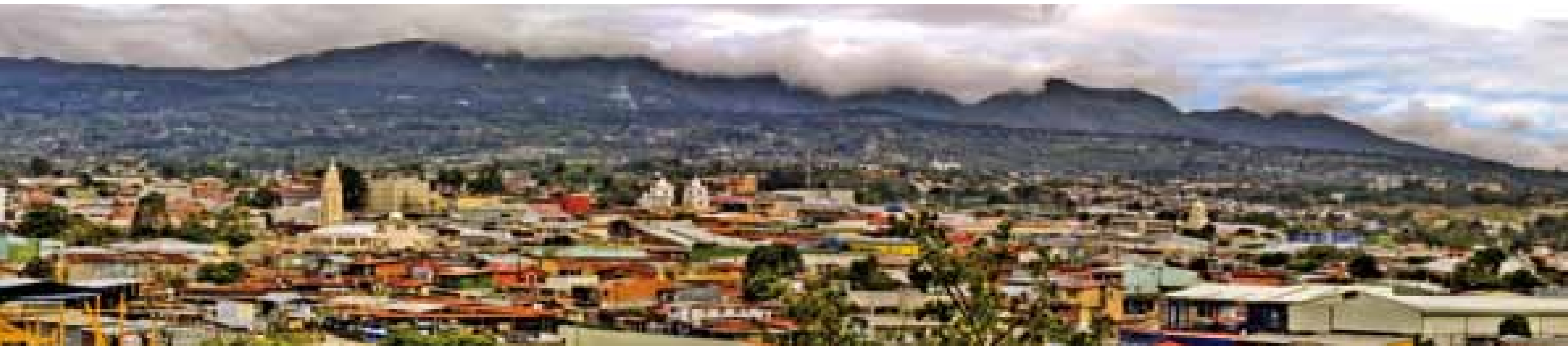
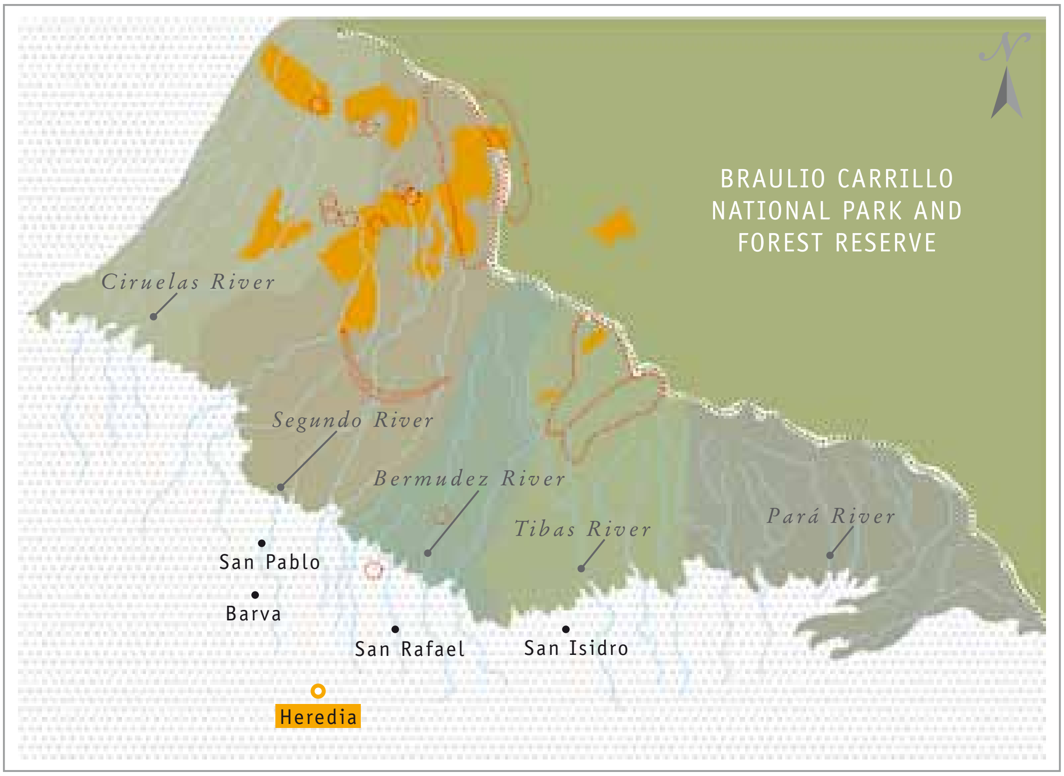


Figure 38

Location of a key area for the protection of watershed services to the town of Heredia and neighbouring settlements, together with the locations of sites where PES schemes have already been implemented



LEGEND

- Areas involved in PES schemes
- Key areas for watershed protection
- Ciruelas watershed
- Segundo watershed
- Bermúdez watershed
- Tibás watershed
- Pará watershed
- Limits of Braulio Carrillo National Park and Forest ReserveSegundo watershed

Adapted from original map by Esteban Ocampo (Instituto Nacional de Biodiversidad – INBio)

© E. Buitrago/ESPH

© FAO

Current pages (from left to right):

→ Panoramic view of Heredia, also known as the "town of flowers", surrounded by mountains and a river network flowing from five different watersheds.

→ Since 2000, a water tariff has made users contribute directly to the cost of forest protection in the upper part of the watersheds providing water to the town.

In 2009, some 35 private landowners voluntarily entered into this PES programme covering an overall area of 1 190 ha, of which the 90 percent is aimed at forest protection and 10 percent at reforestation. The reward scheme for watershed services initiated by ESPH was so successful that it attracted the attention of the private sector: the Florida Ice & Farm, a soft drinks and bottled water corporation, funded 55 percent of the payments made to private landowners between 2002 and 2008 to preserve 311 ha of forest along the upper section of the Río Segundo watershed. However, in 2009, when new legislation increased the rates of water concession paid annually by the Florida Ice & Farm, the company withdrew from the voluntary payment scheme.

The PES implementation in Heredia gives an example on how is possible to set self-sufficient PES schemes on the 'user pays' principle and how such initiatives are potentially compatible with public-private partnerships. However, jointly-funded PES schemes, being voluntary agreements, require a fine-tuned level of legal harmonisation and strategic policies that support the involvement of the private sector.

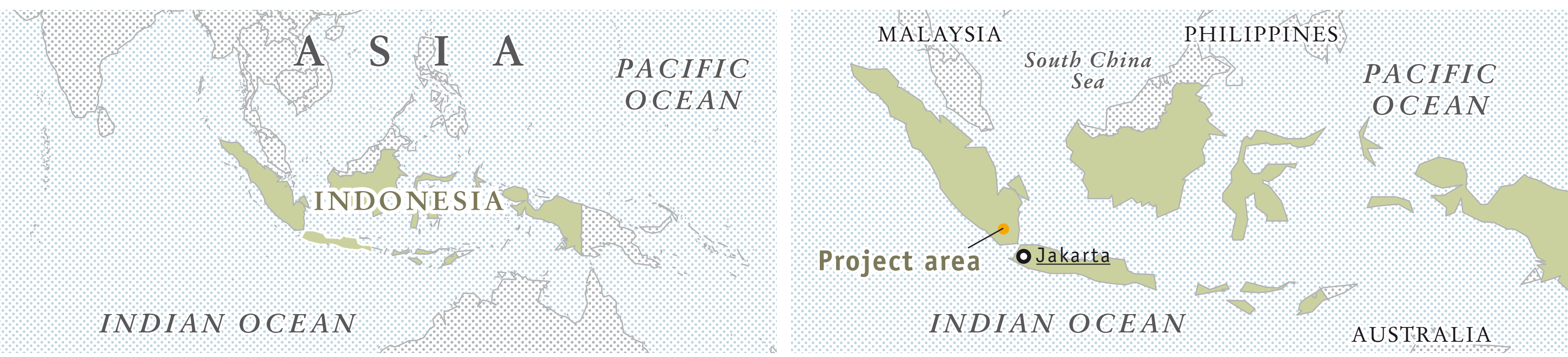
REFERENCES

Gamez, L. 2010. *Internalization of watershed services*. Poster presented at the FAO stakeholders consultation on Food Security through Additional Income: From PES to the Remuneration of Positive Externalities in the Agricultural and Food Sector, 27–28 September 2010, Rome, Italy.

PES AND MULTI-STRATA COFFEE GARDENS IN SUMBERJAYA, INDONESIA

Rachman Pasha and Leimona Beria
World Agroforestry Centre (ICRAF), Nairobi, Kenya

© R. Pasha/ICRAF



Sumberjaya is a sub-district (542 km^2), in the district of West Lampung, which has historically been the dramatic scene of massive deforestation escalating in social conflicts and poor households. Since the 1970s, Sumberjaya recorded a rapid expansion in smallholder coffee cultivation. Although the government was aware of the consequent high uncontrolled deforestation rate, it was only in 1990, when a hydropower plant was planned in the upper watershed of the Way Besai River, that it took action, concerned about slope erosion and potentially high sediment discharge to the hydropower plant (USAID, 2007). Thus, 40 percent of the land in Sumberjaya was declared as areas of restricted use and forest protection and, between 1991 and 1996, thousands of farmers were evicted from their lands. In 1998, a reconciliatory negotiation promoted by the World Agroforestry Centre (ICRAF), the local NGO Watala, the Ford Foundation and the UK Government's Department for International Development (DFID) was initiated to resolve the huge social conflict and promote sound land-use management.

In 2000, as the farmer eviction was ultimately seen as ineffective, a legal decree established a community forestry programme, called *Hutan Kamasyarakatan* (HKm). The programme, equivalent to a public-led PES scheme, allowed groups of farmers jointly applying as a community to obtain legal permission to use the state-owned land. The permission was issued for a trial period of five years with the possibility of extension for a further 25 years. In return, the farmer community commits to protect native forest trees and convert coffee monocultures into multi-strata coffee gardens (Figure 39). In these coffee gardens, coffee is grown together with some vegetables and medicinal plants under the shade of *Erythrina lithosperma*, *Leucaena glauca*, *Albizzia falcata* and various types of fruit trees.

When a contract is signed an inventory of the existing trees on the contracted land is made and the composition of the agroforestry plots to be maintained is set. In addition, the community agrees to protect the natural forest from logging and forest fires, to adopt soil conservation practices and to plant additional trees — seedlings can be obtained from the local forestry office. Performance is evaluated on the overall land, thus, the whole subscribing community is responsible for compliance of PES requirements.

ESTABLISHMENT OF A PES SCHEME

The IFAD-funded RUPES (Rewarding Upland Poor for Environmental Services) initiative has been acting as a facilitating intermediary began in 2004 and this has helped to scale up the success of the *Hutan Kamasyarakatan* initiative. To date nearly 6 500 farmers have received conditional land tenure; this has doubled the local land value, reduced corruption, decreased bribing and consequently increased household income by about 30 percent. Above all, land tenure has motivated farmers to protect the remnants of native forests.

RUPES has also being involved in facilitating a privately-funded PES scheme by launching a pilot study, RiverCare, between the hydroelectric power plant set on the Way Besay River and a community of 70 households, living on 160 ha in the Way Lirikan subcatchment, which is the contributing to major sediment discharge in the Way Besay River (Figure 40). The Way Besay hydroelectric plant, operational since 2001, presently provides 60 percent of the electricity to the province of Lampung. The sediment load can be as high as 3 kg/m^3/second and this creates a reduction in turbine efficiency, damages the plant filter and increases cleaning costs. Under the RiverCare initiative the community received a full payment of USD 1 000 in the first year to cover the implementation costs of digging sediment/litter pits, dead-end trenches, drainage ditches to reduce soil erosion in their coffee plantation, check dams in some rough

Current pages (from left to right):

→ Multi-strata coffee gardens consist of different vegetation layers constituted by timber-, fruit- and shade-based systems.

→ Sediment pits improve the infiltration capacity of the soil and provide better conditions for coffee plant growth.

→ Litter pit to facilitate accumulation of the litter layer and increase of soil protection and fertility.

sections of the river of slow its flow and sediment traps on public foot path and in gullies. In the subsequent years, the community has received payments according to the percentage of sediment reduction obtained (Table 16).

Table 16

Conditional payment scheme based on the reduction percentage of the river sedimentation load

Percentage of sediment reduction	Annual payment received by the community (USD)
≥ 30	1 000
20-29	700
10-19	500
≤ 10	250

RUPES carried out an auction process in the villages of Mulya Indah and Wanasari to estimate the costs that farmers will face planting trees (a minimum of 400 trees/ha, which includes 70 percent fruit trees and 30 percent timber trees) to reduce soil erosion. Particular attention was given to ensure that farmers understood the auction mechanism. Thus, the auction was held in two sessions, one in each village. Participants bid seven consecutive times to allow them to become familiar with the auction process. The bids submitted in the last round were considered as the real auction output. During previous rounds participants developed familiarity with the process and adjusted their estimated opportunity costs on the basis of the previous bidding outcomes. Although there was an expected certain variability in the estimate of the opportunity costs given by participants, there were 19 auction winners in Mulya Indah and 15 winners in Wasanari. In both cases, the contract price per hectare of land under the PES scheme was set close to the average opportunity value estimated by the auction (Table 17).

Table 17

Results of the auction promoted by RUPES/IFAD to estimate opportunity costs of farmers planting trees to reduce soil erosion

		Mulya Indah	Wanasari
Number of participants		48	34
Number of auction winners		19	15
Contract price per hectare of land (USD)		178	167
Opportunity costs estimated by the participants (USD)	Minimum	100	67
	Average	311	269
	Maximum	2 778	778

Recently, the RUPES RiverCare pilot project has been extended to 25 households in Buluh Kapur village. In this case, the first year payment was conditional on a 30 percent sediment reduction. Although the community did not meet this threshold, only being able to reach a 20 percent reduction, the Way Besay hydroelectric power plant delivered the first year's payment as a token of goodwill and effort made by the villagers (van Noordwijk and Beria, 2010).

PES implementation in the Sumberjaya region gives an example on the critical role of the intermediary in facilitating and upscaling publically- and privately-funded PES initiatives. The key task was to re-establish people's basic levels of trust in the government's policy and programmes, which had been disrupted by a history of conflicts on land use and allocation. The intermediary was subsequently able to establish dialogue and mediate between the interests of a major hydroelectric power company in Sumatra and very poor local farmer communities.

Current pages (from left to right):

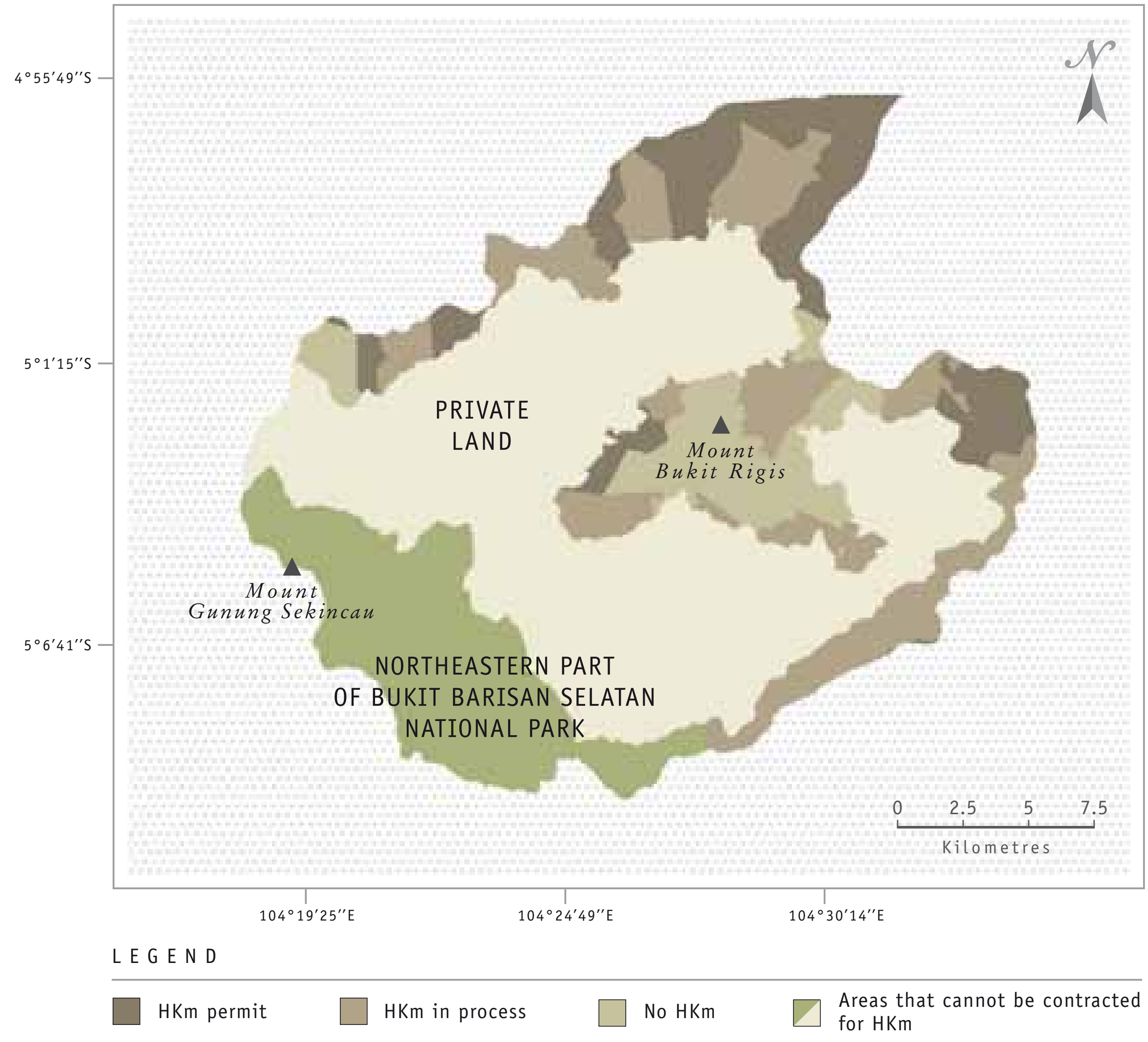
→ Agroforestry of robusta coffee (*Coffea canephora*) provides a suitable habitat for different bird species, although frugivores and specialist and endangered birds will be less represented than in natural forests.

→ Sumberjaya district produces about the 20 percent of the total coffee output of Lampung province.

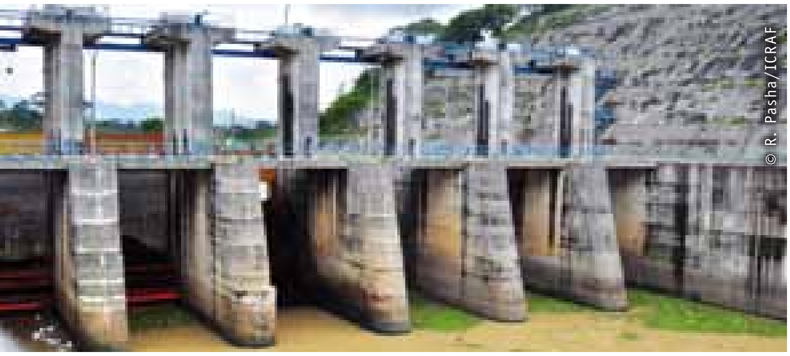
→ Village settlement of Buluh Kapur near the Besai Watershed, which has been involved in RUPES activities aimed at improving the livelihoods of the poor in the Sumberjaya district.

Figure 39

Occurrence of privately-owned and community-owned forests under the community-owned forest programme (HKm) in the sub-district of Sumberjaya



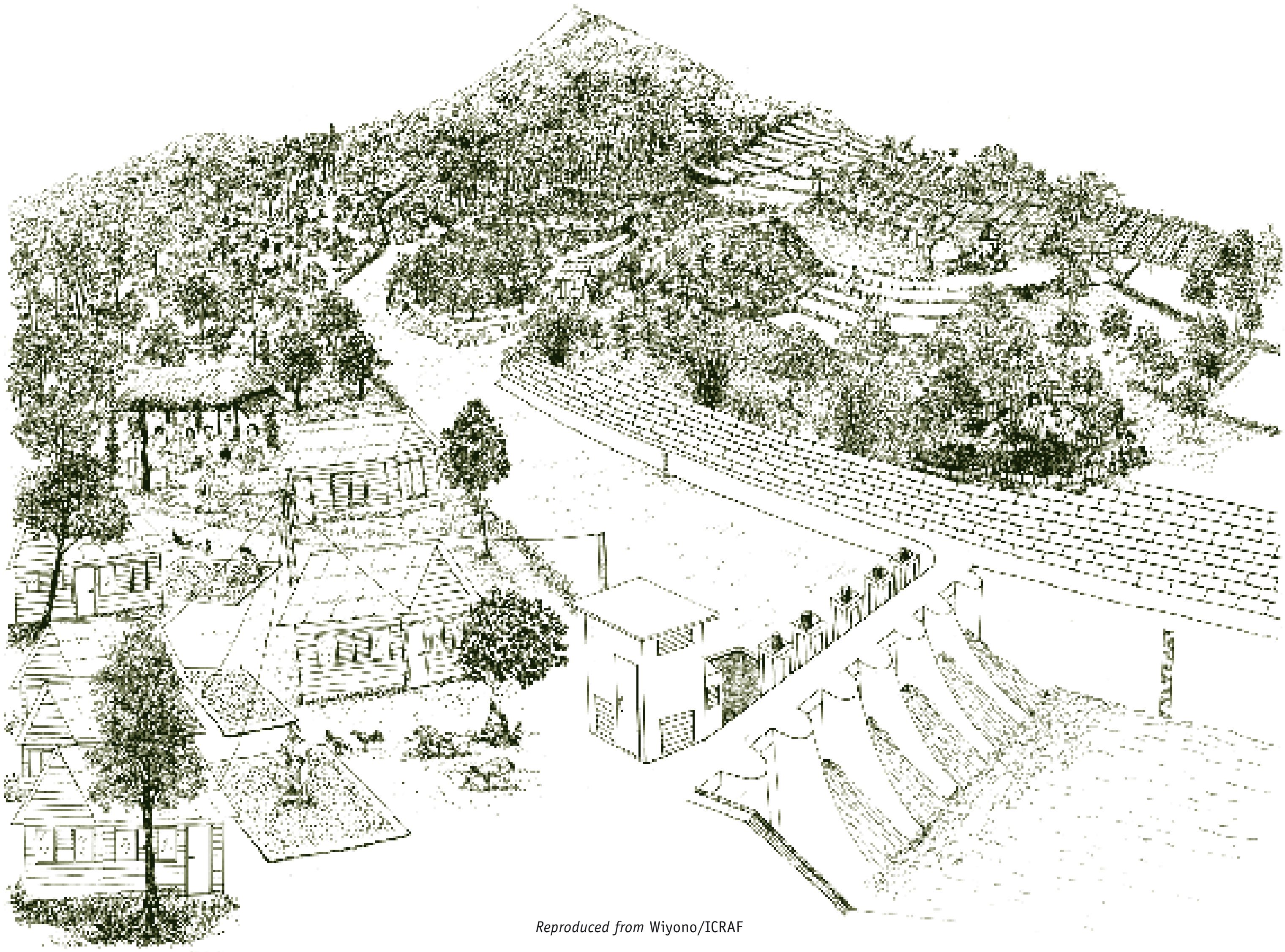
Adapted from original map by Andree Ekadinata (ICRAF)



© R. Pasha/ICRAF

© E. Setiawan/ICRAF

Figure 40
Healthy landscape mosaics and clean water for hydro-electricity



Reproduced from Wiyono/ICRAF

Current pages (from left to right):

→ The Way Besai hydropower dam provides about 60 percent of the electricity for Lampung province, but its functioning is seriously affected by a very high sediment load coming from the upper watershed.

→ All watershed users need to work together to reduce the sediment load downstream.

→ In Sumberjaya, the community forestry programme has resulted in impressive livelihood gains, increased equity and a sense of responsibility for land care.

REFERENCES

ICRAF. n.d. *Site profile: RUPES Sumberjaya*. Bogor, World Agroforestry Centre (ICRAF).

USAID. 2007. *USAID PES source book: Lessons and best practices for pro-poor payments for ecosystem services* (available at http://moderncms.ecosystemmarketplace.com/repository/moderncms_documents/PES_Sourcebook.1.pdf).

van Noordwijk, M. & Beria L. 2010. *Principles for fairness and efficiency in enhancing environmental Services in Asia. Payments, compensation, or co-investment?* Poster presented at the FAO stakeholders consultation on Food Security through Additional Income: From PES to the Remuneration of Positive Externalities in the Agricultural and Food Sector, 27–28 September 2010, Rome, Italy.

Verbist, B., Ekadinata, A.P. & Budidarsono, S. 2005. Factors driving land use change: Effects on watershed functions in a coffee agroforestry system in Lampung, Sumatra. *Agricultural Systems*, 85: 254–270.

Widodo, R.H., Suyanto, S., Verbist, B., Lusiana, B., Susanto, S. & Purnomosidhi, P. 2006. *Rewarding communities for keeping rivers clean? First steps in a RiverCare Program in West Lampung, Indonesia*. Presented at International Symposium on Community Activities for the Conservation of Water Environment, 8 December 2006, Bangkok, Thailand.

Design and layout: Pietro Bartoleschi and Arianna Guida (Studio Bartoleschi)
Printed in Italy on ecological paper, June 2011

Payment for Ecosystem Services (PES) is a tool used by many sectors, including the agriculture and forestry sectors, to reconcile economic activities with environmental conservation. It also is increasingly used for income generation in rural areas and, thus, offers interesting perspectives to support the transition to a green economy and sustainable development. This book reviews state-of-art information and offers new insights on the topic, highlighing key elements in PES design and identifying enabling conditions for PES implementation in different contexts. In particular, this book addresses the linkage between PES and food security. It builds on theoretical perspectives as well as lessons learned through case studies from different parts of the world. It dwells on the different economic, ecological, social and institutional dimensions of PES and suggests innovative approaches for a new generation of PES schemes for improving rural livelihoods and alleviating poverty.

ISBN 978-92-5-106796-3

9 789251 067963

I2100E/1/02.11